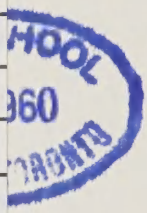

MICROFILM - A History

MICROFILM

A History

1839 - 1900

By FREDERIC LUTHER

THE NATIONAL MICROFILM ASSOCIATION
ANNAPOLIS - MARYLAND

Simultaneously published with this edition of 500 copies in conventional format are editions in the form of 35 mm. roll microfilm, 3"x5" microfiche and 3"x5" microprint cards. The micro editions will remain permanently in print and are available from the

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ONE HUNDRED AND FIFTY YEARS OF PRESIDENTIAL CONCERN OVER THE PROTECTION OF PUBLIC RECORDS

"Time and accident are committing daily havoc on the original (papers) deposited in our public offices. The late war has done the work of centuries in this business. The lost cannot be recovered; but let us save what remains: not by vaults and locks which fence them from the public eye and use in consigning them to the waste of time, but by such multiplication of copies as shall place them beyond the reach of accident."

—*Letter from Thomas Jefferson to Ebenezer Hazard, February* 18, 1791

"It is my hope that the Society of American Archivists will do all that is possible to build up an American public opinion in favor of what might be called the only form of insurance that will stand the test of time. I am referring to the duplication of records by modern processes like the microfilm so that if in any part of the country original archives are destroyed a record of them will exist in some other place."

—*Address by Franklin D. Roosevelt before the Society of American Archivists, February* 13, 1942

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INTRODUCTION

THE LITERATURE of present day microfilming is highly fragmented. There are few books devoted to the subject and details of equipment, processes, applications, achievements, ideas, personalities and related matters are scattered in learned journals, house organs, popular magazines, trade papers and specialized publications, in newspapers, proceedings, transactions and similar often obscure places. Many data are not published at all but exist in reports, memoranda and surveys available only to limited audiences. The fields of application moreover range so widely that few individuals have more than a hazy idea of the scope of the industry. No one really knows the whole story.

For research in microfilming in the 19th century the documentary picture is even worse if that could be possible. Before reading this book few people may have realized that microfilming *has* a history extending back to the very dawn of photography as we know it. Through the genius and work of two men, Dancer the Englishman and Dagron the Frenchman, microfilms became a practical reality more than a hundred years ago. Reductions greater than those now in common use were employed to produce microfilms that could meet the rule-of-thumb test of quality, that is, be enlarged back to original size without substantial loss of definition or legibility. Several of these microfilms still preserved are of excellent quality and

are greatly admired today. They were not isolated laboratory triumphs but resulted from commercial applications which in their day were as successful as they were spectacular. Microfilm copying of manuscripts and historical documents for preservation and use was known and practiced. The beginnings of microfilm in business and industry as well as in science are clearly evident. More perhaps in the way of reproducing scenes and pictures in this form was done then than at the present time. One of the most interesting applications and the best known today was the predecessor of the V-Mail of World War II, the transfer of letters and official dispatches on microfilm by air into Paris during the siege of 1870. The first air mail on any considerable organized scale, the "Pigeon Post" is a monument of postal history; it is as much a monument to successful microfilming. The story is thrilling, complete with escape from Paris by balloon, pursuit by hard riding Prussian Uhlans, disguises and final escape. The subsequent account of work with makeshift equipment and supplies ordered by pigeon to be delivered by balloon, reads almost like a novel. It is here more fully described and documented than in any other single place in or out of print. The achievement, however, was only one culmination of a series of developments that made microfilming a practical tool.

If one had the incentive and drive, the patience, the knowledge or intuition of where to look and the spare time of about twenty years he might retrace the path of the author through the resources of many great libraries, museums and private collections. He could also conduct correspondence with individuals in many countries, translate from all current European languages and find here a scrap, there a fragment and somewhere else a nugget of information. All of these would serve to fill in the giant jig saw puzzle which hitherto has constituted the early history of microfilming. The author

has provided a clear guidebook in his chronology and bibliographical notes for supplemental research and by his trail blazing has eased the path of future students. He would be the first to declare that the whole story has not yet been told, but the reader will be equally ready to believe that without his efforts it is unlikely that future productive research in this field would be immediately undertaken.

Born in upstate New York, Frederic Luther was first attracted to academic life and specialized in the fields of history, archeology and cultural anthropology. In the process he developed both an intense interest in all branches of photography and professional skill as a photographer. His first microfilms in any quantity were made in 1934 when, in Mexico, he undertook to reproduce manuscripts, historical and anthropological material using a Leica camera and accessory equipment of his own design. Five years later he left the academic field to specialize in commercial microfilm work, heading the Photorecord Department of Marks & Fuller, Inc. In 1941 Western Electric managed to interest him in heading a Department devoted to microfilm technology, the production and distribution of industrial motion pictures and the Company Lecture Bureau. In 1951 he decided to enter the microfilm business and established the Frederic Luther Company in Indianapolis, Indiana. For over 25 years he has pursued his avocation of the study of the history of photography and more specifically the history of microfilm. The present book clearly demonstrates the advantages of a scholarly research background tempered by the experience of a successful business man.

A long time member and supporter of the National Microfilm Association, Mr. Luther is now a member of the Board of Directors. He has been a frequent contributor to programs at Annual Meetings and to the Association's news sheet, the *National MICRO-NEWS*. He has held important Committee

Chairmanships and assignments. When the theme of the 1959 Annual Meeting was announced as "A Centennial of Microfilm Progress, 1859-1959", to honor the centennial of the granting of the first microfilm patent to René Prudent Patrice Dagron, on June 21, 1859, it was hoped that Mr. Luther might release some part of the manuscript he was known to have prepared. At first he demurred in the belief that his close connection with the Association would make such publication undesirable. He was finally persuaded to complete a manuscript and permit it to be published under the auspices of the National Microfilm Association in time for release at the forthcoming Washingon, D.C. Annual Meeting in April, 1959.

This edition is limited to 500 copies in conventional printed format but arrangements have been made to keep it permanently in print through the issuance simultaneously of copies in microfilm and microprint formats. The Association is both pleased and proud to assist to some degree in making this fundamental study available to its members and to the general public.

VERNON D. TATE.

Annapolis, Md.
December, 1958

Chapter 1

THE STAGE IS SET

The names of two men dominate the early days of microfilming. To the English scientist, inventor and optical manufacturer J. B. Dancer, whose talents and varied interests left their marks in many fields, belongs the credit for making the first microphotograph and for carrying on many of the experiments which made microfilming a practical medium for reproducing manuscripts, printed and pictorial records.

To the French chemist, portrait photographer and inventor, René Dagron, a man of ingenuity and single-minded purpose, we owe the establishment of microfilming on a commercial scale.

Other names appear in the story of microphotography during the three-score years covered by this History. Many were men of great capabilities and wide renown in other fields. Their talents were not, however, applied in any great degree toward microphotography. To an extent quite unusual in modern technology, current microfilm and micro-opaque techniques, equipment, and applications trace their ancestry directly to the work of the two pioneers, Dancer and Dagron. Many of today's concepts in this burgeoning industry were first employed by one or the other of these men.

Of the two, John Benjamin Dancer was born first. He came into a world trembling under the weight of at least two bitter wars, adding his small voice to the din of the London of George III, on October 8, 1812. England, of course, was embroiled in its second war with its former colonists in America; and the garrison at Fort Dearborn, where Chicago later was to rise, had shortly before been massacred by Britain's Indian allies. On the Continent the kulaks of Tsar Alexander were returning to the ashes of Moscow, and the half-million men of Napoleon were tramping the destiny of their leader into the endless snows of Russia.

The conquests of man over the stubborn allies of economic complacency and social stagnation were beginning to flower in the industrial revolution. A race of technological giants was abroad in the land: Davy, Ampere, Volta and Watt were still alive and active; Robert Fulton and Paul Revere had not yet been gathered to their fathers. Soon to burst upon the world with new and staggering concepts were Darwin, Morse, Wheatstone and McCormick.

Between the birth of Dancer in 1812 and that of René Dagron on March 17, 1819, an entire age passed into the shadows of folklore. Names as familiar as the memories of childhood—names to conjure with—disappeared as the golden leaves of the maple before the onrushing winds of autumn. In 1813 died Benjamin Rush, Zebulon M. Pike, and the Indian Prophet Tecumseh. In 1815 and 1816 it was Frederick Mesmer and Gouverneur Morris. In 1818 America saw Paul Revere slip into the pages of history at the age of eighty-three.

Eagerly receptive to new modes of life and the cultivation of a leisure until then restricted to the moneyed and landed classes, the common man saw his era begin to dawn. In 1819, the very year of Dagron's birth, the first American-built steamboat *Savannah* blazed a trail from Europe to America, a trail

which was to teem with migrating laborers, farmers, mechanics and merchants within a few years. Indeed, while but a few thousand such persons made the westward trek in 1820, the migration swelled until more than five million migrants had followed the industrial rainbow within the next four decades.

Although we tend to think of the Nineteenth Century as one of ruthless economic exploitation of the workers, the long swing of the pendulum of social justice toward a more equitable form of class economy already had set in. It comes as somewhat of a surprise to learn that the Philadelphia cobblers had been unionized as early as 1792. It is even more astounding to find the printers, machinists, hat makers, millwrights, furriers, loom weavers and plumbers organized within ten years after the abolition (on the Fourth of July, 1827) of slavery in the State of New York.

With technology and collective bargaining combining to create a new and powerful class proud to call itself bourgeois, a yearning for some of the luxuries of the aristocracy was quickly spread. Sentiment, and a desire to "keep up with the Joneses" made these people hunger for a means to provide portraits within range of each new genealogically-conscious family.

At the other end of the supply-and-demand channel were artists and technicians who long had sought a means of mechanically recording what their eyes had seen. Indeed, there has been circulated for a number of years a cynical phrase, to the effect that all or most of the so-called discoverers of photography were "terrible painters"; the implication is, of course, that having failed to make the grade with a brush they ingeniously whipped up a clever substitute for their indifferent talents. As is common to many such deceptively simple witticisms, it — aside from the undeniable fact that Daguerre

and some other early experimenters were painters — is a complete misrepresentation of fact.

This is no place to discourse on the relationship of photography to the fine arts. Any reader wishing to follow the argument through to its inevitably inconclusive results is invited to read the recurrent and exasperatingly dull articles which have been popping up in photographic journals for over a century. The rest of us may forget these bombastic generalizations and judge for ourselves the artistic merits of such pioneers in photography as Leonardo da Vinci, David Octavius Hill, and the first American Professor of Fine Arts, Samuel F. B. Morse. We may also note how many of the names of the pioneers given in succeeding paragraphs belong to scientists, not painters.

Before the shopkeepers and the craftsmen of the Nineteenth Century could secure their low-cost portraits the photographic process had to be simplified. The evolution of photography is a fascinating but also a long and complex subject, and must be but briefly summarized here. As every person who ever loaded film into a box camera is well aware, the photographer's camera consists of a track to hold the sensitive film in place, a lens to focus the image on that film, and a box to keep out stray light. This basic construction, with one exception, is found in the camera described by Aristotle, at a time when Alexander the Great was still a child in Macedonia. The exception was that in place of the lens was a tiny opening, acting precisely as does the pinhole aperture "lens" of today's student of photography. This tiny aperture focused the image on a white screen in the back of the camera, while the box was large enough for a person to enter it and trace the image on the screen.

The pinhole aperture was replaced by lenses sometime about 1550; the lenses served to give both a sharper and a

brighter picture on the screen. As time went on the construction of lenses was improved and a translucent screen was substituted for the opaque one; in easily portable form, since the image now could be traced from outside the box, the camera became the tool of many painters. It was used for tracing in the outlines of a subject, leaving more time for the free-hand incorporation of detail, and proved invaluable to many explorer-artists who illustrated the popular travel books of the early Eighteen Hundreds. The engravings of Mayan ruins with which Frederic Catherwood illustrated John L. Stephens' "Incidents of Travel in Central America" in 1839 were made with one of these camera-lucidas.

With the perfection of the camera it was only natural that attempts be made to capture its image photographically. The alchemists of the dark ages were well aware that compounds of silver darkened under certain conditions. In 1727, the year that Isaac Newton died, a versatile German chemist named Schulze proved that the darkening agency was light. By placing black stencils over paper coated with silver chloride he succeeded in making the first photograms, although they were of course, fugitive, for he had no way of preventing the blackening of the rest of the silver sheet when he had removed the stencils.

Although numerous other chemists duplicated the results of Schulze in their experiments, it was not until a century and a half later that the next major advance in photography was made. Then, in 1819, an English astronomer, Sir John Herschel, discovered that a colorless salt compound named sodium thiosulfate would dissolve away all silver compound not previously exposed to light while leaving the exposed and blackened grains of silver unharmed. Thus, with the use of this salt (identical to the "hypo" of the modern photographer), the future of

photography was assured. It now became primarily a job of adaptation and refinement.

Seldom has there been such an air of popular expectancy over an impending scientific development as there was over the prospect of every untaught draftsman becoming his own Leonardo. And yet, the experiments and plans of the photographic pioneers of the Eighteen Twenties and Thirties were shrouded in the heaviest secrecy. This secrecy cost the world's first photographer, Joseph Nicéphore Niepce, his legitimate claim to that title for over 125 years; not until the 1950's did Helmut and Alison Gernsheim discover and publish the historic first photograph, and the process by which is was produced never was in common use.

Finally, in 1839, when Dancer and Dagron both were in their twenties, photography officially was introduced to the waiting world. And when the announcement came it turned out that not one but two basic processes were involved. One of these was the daguerreotype, invented by Louis Jacques Mandé Daguerre, a successful French painter of dramatic canvases in which concealed lights caused the scenes to move and change before the very eyes of the audience.

The second process was the Talbotype, invented by William Henry Fox-Talbot, an English gentleman and a former member of Parliament. These two methods, each vigorously championed on both sides of the Channel, were to share the photographic field for well over a decade, until both were rendered obsolete by the long popular "wet plate."

Without delving too deeply into its mysterious workings, we may note here that the daguerreotype was a metal plate, either silver or silver-coated copper, which was subjected to iodine fumes to make it more highly sensitive to light. After receiving the image produced by the camera lens the plate was developed by being subjected to the action of mercury fumes.

The resulting photograph, a positive or correct reproduction of light and shade in the original, remained on the surface of the original plate. Duplication was possible only by making a number of original snapshots of the scene; later, it became possible to duplicate the daguerreotype by re-photographing the plate itself.

This was the process by which the first microphotographs were made.

Chapter 2

THE ADVENT OF MICROFILM

"We find . . . no miniatures of printed books (holding out the promise of future publications in miniature), or that of condensing in volume for preservation in Museums, etc., the enormous mass of documentary matter which daily more and more defies collection from the mere impossibility of stowage, but which will one day become matter of history."

—Report by the Jury on Photography
(1851 London World's Fair)

Joseph Sidebotham started the whole controversy.

Sidebotham was a well-to-do printer of calico cloth in Bowdon, England. In his spare time he was an enthusiastic microscopist and amateur photographer, travelling to nearby Manchester to meet and talk with other gentlemen of like interests. Out of these talks grew, in 1858, the Microscopical Section of the Manchester Literary and Philosophical Society, in whose founding he was a prime mover.

Sidebotham also was a member of the Manchester Photographic Society, and in 1859 was acting as its vice president. When the vice president arose to speak or to read a paper the assembled members knew that they were in for a lively time.

On the first Wednesday in April, 1859, Mr. Sidebotham arose, addressed the Chair, and immediately launched into his

current paper, entitled "On Micro-Photography." He was annoyed, it soon appeared, by certain claims made in the current newspapers. The guilty articles referred to a marvelous new invention, the making of tiny photographs which were to be viewed through a microscope. New invention, indeed! Why, his friend John Dancer had made such novelties for nearly twenty years. Not only did he, Joseph Sidebotham, have in his possession two of the Dancer microphotos which were over six years old, but he understood that Queen Victoria had long ago been given a set of microscopic portraits of the royal family. "Mr. Dancer's modesty will not allow him to speak of his own discoveries," continued the speaker, "but I am sure you all join in the annoyance I have felt in seeing persons coolly claim as their *own new discoveries* what our respected townsman has accomplished so many years ago".

The publication of Mr. Sidebotham's paper came as a distinct shock to the editor of the *Photographic Journal*, a Londoner named George Shadbolt, who had started making and selling microphotos as novelties in 1854, considering himself the originator of the process. In an editorial he called upon Sidebotham to substantiate his claims.

In his reply, dated May 4, 1859, Sidebotham not only reiterated his earlier claims for Dancer, but included letters from Dancer and from E. W. Binney, a well-known and respected geologist of Manchester. The whole formed a body of evidence so overwhelming that a downcast Shadbolt published as an introduction to the letters, a retraction of his own claims to priority.

If the controversy had shattered the illusions of George Shadbolt, it at the same time established, once and for all, John Benjamin Dancer of Manchester as the world's first microfilm technician. This priority is often overlooked today by many writers on the subject — usually in favor of the founder of

commercial microfilm, the Frenchman, René Dagron — but since 1859, the fact of Dancer's claim to priority never has been seriously disputed.

John Benjamin Dancer was the only son of Josiah Dancer, a versatile and popular English optical craftsman and lecturer. He was born, as mentioned previously, in London on October 8, 1812. At an early age he became an apprentice in his father's business. This was not a natural course to take, for Josiah (his father) had served an apprenticeship in the optical work shop of *his father,* Michael Dancer, and later had been placed under the tutelage of a Mr. Troughton, founder of the firm of Cooke, Troughton and Simms, telescope makers in the city of York; Cooke, Troughton and Simms today is a well-known firm manufacturing engineering and scientific instruments, and is a subsidiary of Vickers, Ltd.

Young John Benjamin Dancer was about five years old when his grandfather died in 1817. About a year later Josiah moved the family business and his five children to Liverpool. Omnivorous in his reading, pedantic in his relations with his fellow man, Josiah Dancer become well known among the bluestockings of Liverpool as a popular lecturer in physics and astronomy. His abundant energy and social graces (he played the pianoforte and the organ) found some measure of additional expression when he helped to found the Liverpool Literary and Philosophical Society and the Liverpool Mechanics' Institute. Proficient in reading the Western classics in Latin, Greek and Hebrew, he also found application for his unusual ability to read the world's most ancient mathematical treatises in their original Arabic and Egyptian texts. What he learned he passed on to others, and it is recorded that the lecture-hungry members of the Literary and Philosophical Society were more accustomed to seeing Josiah Dancer on the rostrum than any other member. Josiah himself taught the classics and the sci-

ences to his son, leaving only the French lessons to a professional tutor. Following the family tradition he soon took John into the business, and the boy soon proved invaluable as an assistant at his father's frequent lectures.

In 1835 Josiah died, and John was left alone to carry on the business. Although he still was in his early twenties, his father's lessons had given him a decided versatility in the sciences, and he continued Josiah's lecture program; it is not at all improbable that the Dancers had found their science lectures to be a profitable form of public relations activity. John also continued the laboratory experiments which he had been conducting throughout his adolescent years. He long had been interested in the optical projector, or the "magic lantern" as it then was called. To increase the brilliance of the screen image, he in 1837 replaced the oil lamp illuminant behind the transparent art slide with a lump of lime made incandescent in a flame of oxygen and hydrogen; this "lime-light" projector was popular throughout the rest of the century and, through its application to theatrical spotlights, has given us such current phrases as "a craving for the lime-light."

A year later, in 1838, Dancer discovered a means for depositing copper electrolytically; at about the same time he invented the rapid action spring make-break contact which made possible such devices as the electric door buzzer. In neither case did he patent his invention. A man of many talents, he was experimenting at this same time with the production of ozone — anticipating Schönbein, who identified and named the gas in 1840.

When the news of Talbot's and Daguerre's success in producing permanent photographs was announced, Dancer immediately began his own experiments with the newly published formulae. Since Talbot effectively discouraged the use of his process by attempting to retain control through patents,

Dancer — in common with many other enthusiasts — took up daguerreotypy. He became England's first commercial photographer located outside London.

Late in 1839, having worked until now entirely from published accounts of the Daguerre process, he set out for London to examine the first exhibit in England of Daguerre's own photographs. It was quite an undertaking, this trip to London, for instead of being a train ride of but a few hours it was a stagecoach journey over rough and rutted post-roads, requiring three whole days. The trip ended in complete satisfaction for Dancer, however, since he quickly realized that his own daguerreotype plates were fully equal in quality to those of the inventor himself.

After his return to Liverpool Dancer began the manufacture of daguerreotype cameras and added them to his already impressive line of optical products. To promote the sale of these cameras he offered to process the plates exposed by the users of his equipment. This item is of interest, for it establishes him as the first commercial practitioner of "D & P" work (developing and printing) in all England, the prototype in fact of the modern drug store's photographic department.

Active as he was with microscope and camera, it seems only natural that Dancer should have attempted to combine the features of the two techniques. And so in 1839 he installed a microscope lens (of one-and-a-half inch focal length) in a camera and succeeded in making a microphotograph. The photograph so obtained was examined under a microscope, and many were the *oh's* and *ah's* emanating from the friends of Dancer who saw it. This, the earliest example of microphotography on record, had for its subject a document twenty inches long; at the 160:1 reduction used by Dancer the image was one-eighth of an inch in length, yet the writing on the document was described as perfectly legible under a 100x microscope.

This ancestor of all microfilm documents has long since disappeared, and we have no other samples of Dancer's 1839 work along these lines. We do know, however, that he continued to make such photographic novelties for a time, and even produced some experimental microphotos with lenses made from the eyeballs of freshly-killed animals.

At about the same time as his microphotographic experiments, he began making photomicrographs, or larger-than-life-size photographs of microscopic subjects. Here Dancer cannot be credited with the first such successful photographs, but it is of passing interest to note that about a year after the introducion of daguerreotypy he was able to exhibit before an assemblage of 1500 persons a daguerreotype of a flea which covered a 6½ x 8½ inch plate. All of his photomicrographs also have disappeared.

Some months afterwards, in 1841, Dancer and his family (for he had married shortly after the death of his father) moved from Liverpool to Manchester. As a business partner he took along a fellow technician, and the new shop was advertised as "Abraham and Dancer, Opticians and Philosophical Instrument Makers." Dancer's first home in Manchester was in suburban Cheetham Hill; in the rear of the house he built a private astronomical observatory. Continuing his interest in the popular lecture series, he became a member of the Manchester Literary and Philosophical Society in 1842, and there made many influential friends, some of whom were even then achieving more than local renown.

One of these was Dr. James Prescott Joule, a twenty-three year old physicist who was engaged in research on mechanical-thermal relationships — research which was to result in the law known to every student of physics as Joule's Equivalent. Dr. Joule was a faithful customer of the Dancer shops, and in 1843 he requested the optician to build several

thermometers for laboratory use; upon their completion the physicist pronounced them the first scientific thermometers with any pretense to accuracy ever made in England.

Abraham soon tired of the partnership; it was dissolved in 1845, after which Dancer continued alone. At about the same time he moved his home and business to a large house in suburban Ardwick, there continuing his flourishing trade in telescopes, sextants, transits, and microscopes. One of his earliest microscope purchasers in Manchester was the noted chemist John Dalton, originator of modern atomic theory; the microscope he built for Dalton was displayed (with appropriate comments on its high quality) before the Manchester Literary and Philosophical Society some 80 years later.

While Dancer continued to make microphotographs on daguerreotype plates, he considered them primarily as novelties, of no great commercial value. The image was weak and required an expensive microscope for viewing, which in turn meant careful control of the light used to illuminate the tiny image. Although he continued to make them for his friends, and customers, his activities in the field were designed to show his technical skill and the high quality of his camera lenses and microscopes. He had about exhausted the possibilities of the medium as long as it was restricted to the metal plate of the daguerreotype.

Meanwhile, several inventors had been working with various materials which would have a greater degree of sensitivity to light than the Daguerre plate, while holding the fineness of detail of that process, yet with a transparency far surpassing that of the Talbot paper negative. The most successful of these processes was introduced by Frederick Scott Archer in 1851, in which collodion nitrate (guncotton), dissolved in ether and alcohol, was coated on a glass plate, which was next sensitized by immersion in a bath of silver nitrate. This was the

long-popular wet plate, which must be collodionized, sensitized, and loaded into a light-proof plate holder, all in very weak light; next placed in the camera and exposed; and finally developed and fixed (again in darkness) before the collodion solvents have had a chance to evaporate.

Dancer, as usual, was quick to grasp the potentialities of the Archer wet-plate, realizing that here was an answer to the drawbacks of the daguerreotype microphotograph. There is no direct evidence to date his first experiments with collodion, but in February 1852, less than a year after the introduction of the process, he made the first collodion microfilm.

Dancer's many-faceted mind was busy with other matters in 1852, and he did not immediately capitalize upon his novel product. At about this time he invented the photographically produced lantern slide, which replaced the hand-drawn slides so popular with Early Victorian owners of magic lanterns. Also during 1852 he made another important contribution to photographic history: the first twin-lens stereoscopic camera. Where the pictures for the stereoscope in Grandmother's parlor hitherto had been made with twin cameras or by making successive exposures with a single camera, Dancer's camera focused the paired images in a single three-pound box on a 3¼ x 6¼ inch plate. He determined the correct spacing of the two lenses (called the interocular distance) to be no greater than three inches, a dimension not materially different from that recommended for similar equipment today.

Dancer's original stereoscopic camera, built of mahogany and equipped with the original matched 4¼ inch, F/5.3 lenses, is in the collection of the Manchester Literary and Philosophical Society. His attempts to patent it were unsuccessful because he had sold such a camera to one of his customers, thus throwing the design into the public domain. Later, however, he did patent an improved model on September 5, 1856.

His interest in microphotos had not flagged during these experiments, although he apparently made relatively few samples. Then, in the spring of 1853, another milestone in the history of microfilm was passed. William Sturgeon, famed for his electrical experiments, had recently died, and three of his friends (including Dr. Joule) had commissioned a local sculptor to carve a memorial tablet in his memory. Edward William Binney, a Manchester geologist of some note and one of the sponsors of the tablet, took Dancer to the sculptor's studios to view the tablet; while there the geologist requested Dancer to photograph the inscription before it was sent to the place of installation, the church at Kirby Lonsdale.

On the same day as Dancer's visit, April 23, 1853, the sculptor delivered the tablet to the photographer's home in Ardwick. Here, two days later, Dancer photographed the tablet on a standard size negative, which he then copied with his microfilm camera, producing a positive image in which 680 letters of the inscription filled a frame but a sixteenth of an inch in length. "Within a month of the last-named date", Binney later wrote him, "in the end of May, 1853, you presented me with a microphotograph of the tablet, which I received with much gratification and surprise, having expected only a common, and not a microphotograph from you."

In addition to the one he gave to Binney, Dancer made several other microfilm copies of the Sturgeon inscription, mounting them with Canada balsam on standard 3 x 1 inch microscope slides for use with 100 power microscopes; these he gave to his friends among the scientists of Manchester, including our old acquaintance, Joseph Sidebotham. These were the microphotographs which, six years later, were to be the evidence which earned for Dancer acknowledgment as the inventor of microphotography.

The extreme interest aroused locally by his microphotos

indicated a lucrative market to Dancer, and some time later he began supplying similar slides to Manchester novelty dealers. The popularity of the slides grew until their manufacture formed a considerable part of Dancer's business.

A description of Dancer's microfilm camera and method of operation has come down to us through his son:

"An ordinary microscope was not used. A bat's wing burner furnished the light (behind a conventional large-size negative) and this was placed inside an optical lantern, the image passing through a lens and condensing system giving a convergent beam of light, the latter finally entering the micro-objective (in this case a ½") from the back. The whole thing was horizontal, and the entire apparatus was enclosed in a canvas-covered tent, a sort of improvised dark room. As a matter of fact, the apparatus was a double one, the same light source serving for two lens systems, one on each side, so that when the work was in progress two people were kept busy changing the negatives and slides, developing, finishing, etc. In this way large numbers could be turned out with little loss of time."

Meanwhile, other photographers had begun experimenting with high-reduction photography, entirely unaware of Dancer's work. That several independent discoveries of the technique should occur contemporaneously is not extraordinary; George Shadbolt, editor of *The Photographic Journal* (forerunner of the *British Journal of Photography*) and one of the claimants to its invention, wrote:

"The production of very small photographs is so obvious a possibility as to suggest itself to many photographers without its even calling forth a remark; and having produced them, those possessed of a microscope would as naturally view them by its aid. We know many who did so".

Although Shadbolt later withdrew his claim in favor of Dancer as the first to make microfilms, he did engage in commercial production of microfilms during 1854. He was the first to use the term "microphotograph" for his high-reduction

films mounted on glass, "for examination only by aid of the microscope, as indeed is a necessity, for they cannot be distinguished without".

"The very word 'micro-photograph' we also coined to describe them, upon the occasion of our supplying Messrs. Smith and Beck, the noted microscope makers of Coleman Street (London), with some which they desired to have for sale. We find an entry made in our pocket book at the time, dated March 29, 1854, when we furnished them with twenty-four specimens...

"The dimensions of these portraits and landscapes ranged from the 1/40 to the 1/20 of an inch square, that is the *one-sixteen hundredth* to the *four-hundredth* part of a superficial *inch,* one of them being a pretty extensive view of Paris. . .

"The lens employed by us was an achromatic miscroscope objective glass of 2/3 of an inch equivalent focus, manufactured by Messrs. Smith and Beck, and the negative was placed at a distance of about threet feet from it."

Another worker at this time was the treasurer of the Photographic Society of London (now the Royal Photographic Society of Great Britain). This gentleman, Mr. A. Rosling, exhibited his results to the Society on March 3, 1853. The Rosling microphotos, being copies of a page from the *Illustrated London News,* are the first newspaper microfilms on record. The photographer, however, had used the printed page not as a means merely of compressing the information contained within it, but as a focusing target for lens-testing purposes.

The best description of these photographs is supplied by Rosling himself:

"In every instance I have found the definition very perfect; and the one now on the table is the eight-hundredth part of the original size: the length of the lines composing the lens is the seven-hundred-and-fiftieth part of an inch, and about half the thickness of the human hair. The thing, by being looked at, will speak for itself as to definition";

whereupon another member, Sir Thomas Wilson, placed in the record: "You can read it quite perfectly".

Chapter 3

THE APPEARANCE OF MICRO-ARCHIVES

"The microscopic uses of the photograph have merely been hinted at, never tried more than as interesting experiments. The recent burning of the (New York) City Hall, though no great loss has been sustained in documents, shows the liability to greater danger. . . Let us imagine the number of wills, or worse — because more are generally interested — of mortgages liable to be destroyed, which . . . would cause boundless litigation. . . A microscopic negative of which, carefully stowed away . . . would give a document as reliable as the original, by which the vexed question of the right of property might be fixed. And yet hundreds of thousands of such negatives might be put away in suitable boxes, in a fireproof vault underground, to be resuscitated upon the loss of the objects from which they were taken . . . I trust the press will agitate it until it is the custom to make microscopic negatives of all valuable public documents."

—*American Journal of Photography*, 1858

"The whole archives of a nation might be packed away in a snuff-box. Had the art been known in the time of Omar, the destruction of the Alexandrian Library would not have been a total loss."

—*Photographic News*, 1859

Rosling apparently did no microphotography beyond this one experiment. But his account, augmented by the growing popularity of the Dancer slides, caused many other photographers to produce photographs of reduced dimensions and to

apply the process to other fields. During World War II, Dr. Fremont Rider, then Librarian at Wesleyan University in Middletown, Connecticut, published a study of the phenomenal but predictable growth of university libraries. Using the Yale University collections as an example which illustrated the statistical norm, he showed that the Yale Library had doubled in size every sixteen years. By projection of his statistics of the past two centuries of its existence, he predicted that, unless greater attention were paid to the acquisition of material in microform, its 80 miles of shelving would grow to 6,000 miles by the end of the next hundred years.

Statistically, Yale should have had at this time of the 1851 World's Fair, some 1½ miles of shelving; actually, the shelves totalled 1¼ miles. Yet the Jury on Photography accurately foresaw (in the quotation heading Chapter 2) the day when microfilm would be called upon to bring relief to the world's great libraries.

Other men took up the challenge.

The May 21, 1853, issue of the famed English weekly, *Notes and Queries*, carried a letter to the editor from a Dublin scholar asking: "May not photography be usefully applied to the making of catalogues of large libraries?" The letter went on to suggest that librarians should replace the laborious job of manuscript transcription and cross-indexing of titles with a standardized photographic copy of each volume's title page, from which five prints could be made for cross-indexing purposes. Similar suggestions from its readers bombarded *Notes and Queries* over the next three years.

It was another English periodical, however, which carried the first positive statement suggesting microfilm in its modern sense and on the modern scale. Published in *The Athenaeum* for July 9, 1853, it is in the form of a letter to the editor from

Sir John Herschel, British astronomer and physicist — and discoverer of photographer's hypo — enclosing a letter written to himself by his brother-in-law, John Stewart.

The Stewart letter is dated June 11, 1853, and deals primarily with the new technique of making enlarged paper prints from small negatives. Then, in the final paragraph, Herschel is reminded that:

"Should your old idea of preserving public records in a concentrated form on microscopic negatives ever be adopted, the immediate positive reproduction on an enlarged readable scale, without the possibility of injury to the plate, will be of service."

Herschel, in his letter of July 6, 1853, enclosing the Stewart document, writes:

"In reference to its concluding paragraph, I will only add, that the *publication* of concentrated microscopic editions of works of reference — maps, atlases, logarithmic tables, or the concentration for pocket use of private notes and MSS, &c &c and innumerable other similar applications — is brought within the reach of anyone".

In the autumn of 1853 our old friend Sidebotham turned to experimenting with microfilms. Following Dancer's instructions he made a few examples before he decided that the results were not worth the effort required. However, he retained them as curiosities to show his friends for some years thereafter.

At about this same time, Dr. Hugh Diamond, an outstanding amateur photographer and later editor of the *Photographic Journal*, made the first known microfilm copy (as distinguished from Dancer's micro-opaques) of a public document, as suggested by Herschel. The original, a manuscript dating from the Fourteenth or Fifteenth Century, contained a number of charters, or articles of incorporation. Diamond reduced this document to an image 1½ x 2 inches in size.

It was not until the early part of the month of March,

1854, that George Shadbolt began making microphotographs and, as was the case with Rosling, his experiments were for testing purposes; he used the technique to determine the resolving power (i.e., capability of reproducing extremely fine detail) of various batches of collodion plates.

Entirely unaware of the earlier work of such men as Dancer, Sidebotham and Diamond, Shadbolt could not have failed to know of Rosling's experiments of the year before, for the two men were close friends, and Rosling was one of the first to see Shadbolt's results. Nevertheless, Shadbolt later emphasized that the idea was original with himself, and that he was at the time entirely in ignorance of any prior production of photographs of microscopic dimensions.

In all probability Shadbolt did not consider the work of his fellow Londoners, Rosling and Diamond, sufficiently "micro" to be classed as microscopic photographs; their results were in the form of images a half-inch or more in length, while his own portraits and landscapes "ranged from 1/40 to the 1/20 of an inch square".

It is not clear which photographer—Shadbolt or Dancer—first established a trade in novelty microphotos. Dancer remarked in 1859 that "this (his microfilm of the Sturgeon inscription) and other microscopic photographs were well known in this locality long before they had been supplied by me to dealers in such articles; but when they first reached London I cannot say." Shadbolt's first acquaintance with Dancer's work (although he did not at the time know it was Dancer's) was in the spring of 1855, when a specimen turned up in the capital.

John Benjamin Dancer, meanwhile, had not neglected his many other interests, and on March 9, 1855, he received an honor coveted by every astronomer in the English-speaking world: he was elected to the Royal Astronomical Society. A

year and a half later, on September 5, 1856, he was granted British Patent Number 2064 for an improvement on his original (unpatented) twin-lens stereo camera. During this same year (1856) Dancer presented to Sir David Brewster several examples of his microfilm work. Sir David was a Scottish physicist who had in 1816 invented the kaleidoscope so popular in Victorian parlors, and in 1831 had been the prime mover in the founding of the British Association for the Advancement of Science. A man of vision and of boundless enthusiasm, he spread the fame of the Dancer microphotos far and wide. It probably was Sir David who was instrumental in seeing that the young Queen Victoria received from Dancer a set of micro-portraits of the royal family.

Two years before he died in 1866, Brewster gave the following account of the Dancer microphotos: he had received

> "a number of beautiful miscroscopic photographs, consisting of a single portrait, groups of portraits, and monumental inscriptions. In order to show these to strangers not accustomed to the use of small single microscopes, I employed a lens of such thickness, that the photograph was seen distinctly by placing a form of the single microscope which I had described and used upwards of forty years ago".

This magnifier, popularly confused then as now with the "Stanhope lens", is more correctly designated a "Coddington magnifier", even though it properly should be ascribed to Sir David Brewster. It is a simple plano-convex lens of such thickness that the focus of its spherical curvature coincides with the flat surface of the lens. This type of magnifier was to play a major role in the future development of microfilm.

A few months after Dancer had given him a set of his microphotos, Brewster made a trip to the Continent. He later wrote:

> "When I was in Italy in the winter of 1857 Mr. Dancer's photographs were exhibited in this way (i.e., by means of the Brewster magnifier) to the

Pope and Cardinal Antonelli at Rome, and at Florence the young Grand Duke and Grand Duchess of Tuscany, the Marquis of Normanby, Professor Amici, and others. The interest excited by these photographs was so great that I showed them to the distinguished jeweler, Signor Fortunato Castellani, and suggested to him the idea of constructing brooches containing precious stones, so that the photographs might be placed within them, and magnified by one of the precious stones, or by colourless topaz or quartz formed into a lens".

After having exhibited the photographs in Paris, Brewster returned to England. Here he resumed work on his articles on micrometry and microscopy, for which he had been commissioned by the editors of the eighth edition of the *Encyclopaedia Britannica,* then in process of publication. These articles, appearing in volume fourteen of the *Britannica,* were published in October 1857, and included the following passages:

"Among the wonders of microscopic photography not the least interesting and useful are the fine microscopic portraits taken by Mr. Dancer of Manchester, and copies of monumental inscriptions so minute, that the figures in the one, and the letters in the other, are invisible to the eye. A family group of seven complete portraits occupies a space the size of the head of a pin; so that *ten thousand* single portraits could be included in a square inch. They are executed upon films of collodion as transparent as glass; so that a family group could be placed in the centre of a brooch, a locket, or a ring, and magnified by the central jewel cut into a lens sufficient to exhibit the group distinctly when looked into or held up to the light.

"Microscopic copies of despatches and valuable papers and plans might be transmitted by post, and secrets might be placed in spaces not larger than a full stop or a small blot of ink."

And again:

"A new method of constructing microscopical scales or systems of delicate lines, opaque or transparent, and fitted both for astronomical and microscopical observations, has been recently proposed by Sir David Brewster. Mr. Dancer of Manchester has succeeded in making photographic portraits upon collodion so small that they are wholly invisible to the eye, and that *ten thousand* portraits may be introduced into a square inch. The film

of collodion upon which these photographs are taken is so thin and transparent that it is invisible, and allows objects to be seen through it as distinctly as if it were the thinnest glass. If a system of opaque or transparent lines therefore is impressed upon it photographically, when reduced to the minutest size from a system of large and sharply defined lines, we shall have the most perfect micrometrical scale that can be conceived, the portion of the collodion that contains no nitrate of silver being as transparent as if the dark spaces were solid wires or metallic plates placed in the focus of the eye-glass."

Brewster's enthusiasm for microphotography caused a great flurry in the photographic world. In September 1857 members attending the meeting of the British Association for the Advancement of Science in Dublin were shown not only a collection of Dancer's slides, but also viewed a similar collection made by a Frenchman named Bertsch and exhibited by that nation's delegate, the abbé Moigno.

On November 5, shortly after the appearance of the *Britannica,* George Shadbolt addressed the London Photographic Society and established himself, so he thought, as the originator of microphotography; this he did by a description of his 1854 experiments. He was led into thinking this by Brewster's having mentioned no date other than that on which he had received his gift of microphotos from Dancer; i.e., 1856.

The *Photographic News,* in 1858 and 1859, noted an increasing interest in the making of microphotos. In addition to publishing a description of the processes involved, it carried notes on the possibilities of safeguarding archival material from loss by fire, on its application to intelligence by means of spies carrying reduced plans in hollowed buttons, and to militarism by shooting dispatches out of besieged and encircled cities in hollow musket balls, all to be accomplished by the new marvel, microfilm. A like interest was shown by the editors of American newspapers. For example, a Dr. Channing of Terre Haute,

Indiana, showed some microfilms to the editor of the *Terre Haute Wabash Gazette,* on May 24, 1859; the editor expressed his amazement in print the following day:

"That which seemed a mere point to the unassisted eye, when placed under the power of the lenses are lines of many words, whole verses, portraits and pictures of many characters. It seems beyond the reach of science and of genius how this can be, but the fact is before us, and we can only look and wonder".

During 1859 a number of French photographers and opticians exhibited microphotos at the Paris Photographic Salon. As Louis Figuier wrote in 1860, in his booklet describing the Salon:

"The microscopic photographs were the marvel of the Exposition. They quite rightly succeeded in holding the visitor's attention, for they give the most astounding idea of the delicacy of the photographic impressions and truly confound the imagination".

Also in 1859 occurred the Dancer-Shadbolt controversy over priority in the production of microfilm. As set forth earlier, Joseph Sidebotham opened the controversy by reading a paper before the Manchester Photographic Society on April 6; the matter was closed by the publication of George Shadbolt's quitclaim on the fifteenth of May.

Chapter 4

AN INDUSTRY IS BORN

"We have not yet seen anything in the photographic line more beautiful than the tiny pictures now made and inserted in little microscopes".

Editorial in *Philadelphia Photographer,* 1866

RENÉ Prudent Patrice Dagron was born March 17, 1819 in the hamlet of Beauvoir, Department of Sarthe, some 97 miles southwest of Paris. At the time Beauvoir was a charming little village of a hundred inhabitants, perched on the edge of the rolling Perseigne Forest, which stretched away westward. Across the forest about twelve miles away is the city of Alençon, where the northward-stabbing American Third Army nearly pinched off the German escape route from Normandy in World War II; thirty miles a little to the west of south stands the capital city of Le Mans, near which in 1908 the Wright Brothers introduced the flying machine to Europe.

While John Benjamin Dancer was learning the optical business in Liverpool, René Dagron was growing up in rural France. Beauvoir lies in fertile country; three streams flow through the commune, and the soil is a sandy clay, cultivated principally in rye and oats. The hilly environs for generations had been planted in oak, chestnut and birch, and the men of Beauvoir did a small business in lumber; from the orchards

near the village they gathered the apples whose pressing gave to the Beauvoir cider its richly deserved fame. The industry of the women included the bleaching of thread and the raising of hogs and geese for the Paris market. Percheron horses in some numbers were raised here, the origin of this long-popular breed lying in Perche, but a few minutes' walk to the east. When Dagron was young the Percheron was bred for the stagecoach trade, but since the advent of the railroad the strain has been increased in weight and strength for draft-animal purposes, though it still is hard-limbed and active and able to maintain a steady trot over considerable distances.

The life of a peasant was not for René Dagron, and at an early age he left Beauvoir for Paris. In the capital he proved an apt student in physics and chemistry, lusty young sciences in the early Nineteenth Century. As a student chemist, the twenty-year old René was more than casually interested in the disclosure of daguerreotypy on August 19, 1839. Undoubtedly, he had heard speculations on the closely guarded secrets of the process ever since the inventor's success had been announced nearly seven months before.

It is quite probable that while Dancer was making the first daugerreotypes ever produced in the British provinces Dagron was polishing and fuming the silver plates in Paris. The introduction in 1851 of Archer's collodion wet-plate laid the foundations for the later work of both men, while Taupenot's collodio-albumen dry plate of 1855, and Archer's patented collodion stripping method of the same year, provided Dagron with the processes which later were to make him famous. His first step, however, was to establish a photographic portrait studio.

The Dancer microfilms shown by Brewster in Paris in 1857 caused great excitement among the French photographers, while his suggestions that such photographs might be applied to

the manufacture of novelty jewelry aroused the interest of French opticians. Dagron was not yet forty at this time. Not having cut much of a swath in Paris with his portrait business, he was badly in need of a novelty to lift him out of the shadow of more popular portraitists, such as the spectacularly successful Nadar. "Microphotography", Dagron told himself, "has great possibilities — if handled right".

In the meantime, the jewelers and opticians of Paris had not been idle: at least two of their number had introduced minute photographs placed in tiny opera glass watch charms, with a magnifier in the charm to enlarge the picture. Also, as we have seen, the microscope shops in England had been supplied with microphotos by Dancer and Shadbolt for years, while Sir David Brewster had printed his suggestions for their application to the trinket trade as early as 1857. "Nevertheless", pointed out the *Société française de photographie,* "there was an important difference between these isolated attempts and the considerable development given by M. Dagron to the introduction of microscopic photography to the novelty trade".

On June 21, 1859, Dagron received the first microfilm patent ever granted (France. No. 23,115). The features of this patent, shown in Fig. 6, were the simplicity of construction and the minuteness of size: so compact was the assembly that it could be built into the keys gentlemen carried for the winding of their pocket watches.

This model was the ancestor of a considerable progeny of simple microfilm viewers. Similar viewers are manufactured and sold today, and most readers will remember those souvenir trinkets (disguised even yet as miniature opera glasses, finger rings or what have you) which, when held to the eye, depict the majesty of a Niagara — or the pellucid beauty of an unclad Eve — depending of course on where one buys the viewer. Suggestive and indecent microphotos, made by some of

Dagron's competitors, were on the market at least by 1874; more than any other cause they for a time retarded the general accepance of microphotography.

Protected by his patent, Dagron set out to introduce the novelties he called his "microscope-bijoux". His method in achieving this end would do credit to a modern publicity man. On a day when the police reporters assigned to the prefecture on Champs Elysees were engrossed in their never-ending game of cribbage, in walked a gentleman to report that he had just found a most unusual ring on the boulevard. It is not difficult to imagine the desk sergeant as he picks up the ring, places his eye to a tiny opening pointed out by the stranger, and shouts to the waiting gendarmes and reporters:

"Pierre! Jean! All of you! Take a look at this!"

Such a curious find on the fashionable promenade was a godsend to the bored and sentimental newsmen, and all Paris was treated next day to paragraphs of rhapsodic prose on the polished boulevardier who could, in a bustling capital, gaze in all seemly privacy upon the features of his loved one, to weep or tenderly to smile at the precious memories thus evoked.

It was with the timing of a master publicist that a modest, middle aged businessman diffidently presented himself at the police station next day to claim the "lost" ring — not only as owner but as creator as well.

The newshawks, well aware of the interest aroused in the city by their effusive descriptions of the ring, pressed the photographer (for it was, of course, our René Dagron) for further details. Thus it was that Paris once again read of the marvelous jewelry, and learned that its ingenious manufacturer, M. Dagron, would make such delightful novelties available to all who came to his studios at 66 rue Neuve des Petits Champs.

Public response to this generous offer was immediate, as indicated in the following passage published in an English journal not long afterwards:

"When the *bijoux* of M. Dagron made their first appearance, an unanimous feeling of astonishment and admiration was excited. Nothing could be more extraordinary, in fact, than to find in the setting of a ring or of a pin, through an almost imperceptible hole, a portrait or other subject of the size of a *carte de visite*. The public enthusiasm in connection with this novel and interesting application of photography, and the eagerness to possess the precious treasures, excited among photographers a general desire to make the most of this recent discovery."

Thus, hardly had Dagron begun to reap the profits of his ingenious idea before a host of competitors arose to share his market.

Despite the heavy competition offered by his competitors, Dagron found business in his novelty jewelry so good that he was moved to expand his workshops again and yet again, until within thirty months after his first patent was granted he had a force of 150 workmen turning out trinkets which sold at but a few cents apiece. Forty years later a writer was to reminisce nostalgically about a product of the Dagron ateliers, the bone penholder of his schooldays; this he described as containing "a photographic image, the size of a point of a needle", on which was copied a microscopic calender rendered perfectly legible by the lens.

But Dagron was not content merely to hold his own against his competitors; in an attempt to gain a monopoly of the trade, he overreached himself, and thus suffered his first real setback. In the early summer of 1861 he brought suit against another French inventor named Martinache, charging invasion of his patent. Martinache, defending his own microfilm viewer patents of April 4 and May 7, 1861, successfully fought the suit, and Dagron & Company finally purchased the Martinache

process for approximately $6,000 on July 23. The price, very high for the times, indicates the high commercial value placed on the business.

During this time Dagron's attorneys had been busy protecting him abroad. On March 28, 1860, he received a British patent based on claims similar to those made in his original French patent, and on August 13 of the same year he was granted U. S. patent No. 33,031, based on like claims.

On July 18, 1861, one of his employees, a M. Berthier, was granted French patent No. 50,469 on a very ingenious process. This consisted of cementing a thick glass plate (bearing a microfilm on its inner surface) to each end of a small block of optical glass. The entire assembly was then placed in a grinding jig which transformed the flat end-plates into convex lenses, each focused on the image borne by the opposite plate. The end result was a cylinder of glass whose rounded ends acted as lenses. By placing one of these lenses to the eye the image lying opposite was enlarged, while the closer image was so tiny and so far out of focus as to be invisible. It was, of course, merely a clever adaptation of the Brewster magnifier, but it became so popular as to supersede most of the earlier models in the Dagron workshop. Dagron took out a duplicate patent on these claims in England on September 19, 1861. To make the construction of the viewer more easily understood the drawings accompanying this patent are reproduced in Fig. 8.

At about this same time Dagron brought suit against a group of fifteen opticians in Paris for the manufacture and sale of viewers in defiance of his patents. The fight was bitter but short-lived. Dagron supported his action with his patents of June 21, 1859, and March 8, 1860, and with the Martinache patents of 1861. It is interesting to note that at the trial he stated that he did not consider himself inventor either of the

microphotograph or of the means of viewing the tiny pictures. He did consider that he was the originator of the idea for incorporating the image and its viewing lens in jewels and trinkets, and that he was the first successfully to manufacture the viewers in their present minute size. On this basis he claimed the exclusive right to manufacture and sell all viewers having such dimensions and incorporating permanently affixed images. The court, however, held that "prior to 1859, microscopes of minute dimensions and contained in metal cases had been fabricated and placed on sale". The court further observed that "extrinsic modifications of an optical instrument whose discovery dates back for nearly three centuries and which has been made in so many diverse forms" could not form the basis for a patent. Granting that Dagron had succeeded in achieving a minuteness in size not previously realized, still the principles of his viewers were in use by other optical manufacturers to the date of his patent. Finally, the court held that the description published in the *Encyclopaedia Britannica* in 1857 constituted publication sufficient to place the idea for incorporating viewers in jewelry within the public domain.

Dagron lost no time in carrying an appeal to the Correctional Tribunal of Paris. Here the presiding justice, M. de Lelain-Chomel, handed down an opinion on January 28, 1862, which upheld the lower court's decision, nullified Dragon's patents, and thus broke his monopoly. The appellate court did, however, emphasize its belief that Dagron had acted in good faith in bringing prosecution: while assessing to Dagron all court costs it dismissed the pleas of the opticians for damages. It also denied the petition of some of the delegates, who had asked — in a spirit indicative of the bitterness of the trial — that the decision be published in the newspapers and placarded all over Paris. To crush even further their energetic com-

petitor, Dagron's rivals later had him prosecuted for photographing the statues of the Louvre and including them in his "Views of Paris".

René Dagron was not one to be stopped by these setbacks. His fertile mind was already at work on new advertising projects, and he applied for permission to exhibit his wares at the 1862 World's Fair in London. Aimé Girard, Professor of Chemistry at the Imperial Polytechnic School, was delegated by the jury on admissions to inspect the Dagron studios. M. Girard visited Dagron's workshops on this mission during October 1861. Thoroughly impressed by the businesslike activity of the establishment, Girard not only recommended him to the jury on admissions but also undertook to describe to the influential *Société française de photographie* the studios and the processes involved.

All in all, 1861 was an eventful year for René Dagron. A son, who became the noted Parisian physician and medical writer, Georges Dagron, was born on April 17. The Dagron Company had filed suit against Martinache and had paid out $6,000 for the Martinache viewer patents. The Company had filed suit against a powerful group of competitors. Dagron himself had been granted patents both by the United States and by Great Britain. One of his employees had received a French patent on a new type of viewer, and this viewer already was being placed in production. The company was planning an exhibit for the London Exposition. He had been formally recognized at last by France's leading photographic society. And his workshops hummed as his 150 employees turned out enormous quantities of inexpensive microfilm viewers. Four other patents were granted in 1861 to the inventors Cuvillier and Héricé.

The next year, 1862, also started off with a bang. Soon after he lost his appeal against the opticians, Dagron began to

assemble the materials for his exhibit in London. Then, as part of his policy of institutional advertising he presented a set of microphotos to England's Queen Victoria, timed to be acknowledged during the Exposition. At the same time, having become reconciled to the loss of his monopoly, he swung to the other extreme and began selling microphotographic equipment and supplies to amateurs and to his professional competitors (E. and H. T. Anthony & Company — later to become Anthony & Scoville and still later the Ansco Company — acted as his American distributors in the eighteen-sixties.) He published a 36 page booklet which he called "Cylindres photo-microscopiques montés et non-montés sur bijoux, brevetés en France et à l'étranger". That his advertising media were well chosen is attested in the "Scientific Record of the International Exhibition of 1862", which says:

"The photo-micro-jewels of Dagron sold in large numbers in the French Department of the Exhibition".

In 1864 Dagron published another booklet, "Traité de photographie microscopique", (see section on Documents and Notes) which sold for fifty centimes and is today his second best known piece of writing. In its thirty-six pages he not only describes in minutest detail the process he follows in making microfilm positives from standard size negatives, but he includes an appeal to the sentimental instincts of his readers:

"We offer to all, at a price more than reasonable, the means of producing economically and with the greatest of ease those little cylinders called 'stanhopes,' . . . mysterious objects wherein each can hold that which is most cherished in the world".

He assumes unto himself the well-deserved honor of having created the microfilm industry, dating its birth from his 1859 patents:

"Microscopic photography has become in five years' time truly an industry drawing unto itself over two dozen tributary crafts, notably the

trinket trade. No one else has practiced to such an extent as we the industry we have created".

And he ends by printing a price list of every manner of equipment necessary to the microfilm producer: Reducing camera (complete with lens), 110 francs; cup of Canada balsam to attach microphoto to the stanhope (Brewster magnifier), 5 francs; stanhope magnifiers, 8 francs per gross (a little less than a penny apiece).

Dagron's "Traité" was an immediate success, and was reprinted and abstracted in many of the scientific periodicals of the time, even finding its way into the journals of other countries.

At the January 1864 meeting of the Photographic Society of Scotland, Sir David Brewster read a paper which, for the first time, gave the true relationship of both Dancer and Dagron to the development of microfilm technique. Dancer is presented (by implication only, however), as the originator of the process, while the author pays tribute to Dagron's "ingenuity with which he had produced a new article of manufacture". This accolade is of particular interest, for it was Brewster's contribution to the *Britannica* in 1857 on which rested the adverse decision of the court in the patent suit of 1862.

Brewster went on to express regret that the Jury on Awards of the 1862 Exposition had seen fit to present only an "Honourable Mention" certificate and not a medal to Dagron for his exhibit. For the benefit of the Society Brewster described a typical *bijou* being marketed by the Dagron studios at this time:

"We have now before us one of M. Dagron's photomicroscopes, containing a photograph of Sir Walter Scott, and sold at Messrs, Knox, Samuel, and Dickson's for one shilling. The cylinder lens is only *one-third* of an inch long, and its diameter *one-tenth* of an inch. It is placed within the

eye-end of an ivory tube, which screws into a larger piece, so as to resemble a minute opera glass. The larger or object-end has an aperture of *one-twelfth* of an inch, and the smaller or eye-end an aperture of *one-twenty-fifth* of an inch, through which we see the portrait as large and distinct as if it were an oil picture on the wall"!

Meanwhile, Dagron was not ignoring the other avenues of advertising, and we find him buying space in the 1864 city directories to draw attention to his business, located not far from the Place Vendôme in central Paris:

"Dagron & Co. Microscopic photography. Rue Neuve des Petits Champs, corner of rue d'Antin.

"Patentee in France and Abroad. Microscopic photographs, unmounted and mounted in jewels as well as in rings, pins, watch-keys, watch-charms, wedding rings (containing the portraits of both the wedded pair without increasing the size of the ring). Pen-holders containing a perfectly legible microscopic calendar. Precious, semi-precious, and colored stones containing photographs invisible to the naked eye, etc.

"This ingenious discovery, a photographic innovation introduced by M. Dagron, combines the useful and the valuable with the greatest of novelty. It is extremely interesting to view, either alone or together, the portraits of an entire family, with fidelity of resemblance and a three-dimensional quality, the whole embodied in the most delicate jewels.

"Photographs of all kinds and sizes. Manufacturer of apparatus for microscopic photography.

"This establishment is remarkable for the unusual location of its immense studios and its magnificent salons, occupying the second floor of the imposing building at 66 rue Neuve des Petits Champs".

Unusual location is right. Located in the Gaillon Quarter of the Bourse, the rue Neuve des Petits Champs was the prototype for Thackeray's ""New Street of the Little Fields". In a building close by the Dagron studios the first Napoleon had married his Josephine. At the time of Dagron's residence at Number 66 he had as co-tenants in the same building a bakeshop, a couturiere, a beauty shop, an attorney, and a surgical

bazaar. Seventy-five years later, as World War II broke out over Europe, the neighborhood was little changed, and housed a variety of photographers, cafes, lawyers, and dress shops.

As indicated in the advertisement quoted above, the increasing notice accorded Dagron's work was not limited to the photographic world; later in the same year (1864) the Emperor (Napoleon III), who worked hard to gain a reputation as patron of the arts and sciences, authorized Dagron to assume the title of court photographer.

Carrying on his program of exhibits Dagron had a booth at the 1865 Exposition de Porto and there was awarded the "Medal of the Second Group".

About a year later an editorial by the influential Edward L. Wilson appeared in his *Philadelphia Photographer* and aroused a considerable amount of interest in the microfilm process. That Wilson was aware of the fame of Dancer and Dagron is indicated in the following paragraph:

> "In Europe this branch of photographic portraiture is making rapid strides. At Manchester, England, there is a very large establishment engaged in producing not only portraits, but all sorts of copies, views, &c, on slides for the microscope. In Paris there is a similar establishment, under the care of M. Dagron, we believe, *employing over one hundred and thirty persons in this branch alone*".

Similar exploitation in America came slowly. The collections of the American Museum of Photography in Philadelphia contain today several microphotos mounted on microscope slides, made by the Langenheim brothers. They cannot be dated positively, but probably were made sometime in the Fifties.

In the autumn of 1863, Colonel N. Pike modestly reported to the American Photographic Society that "having been very successful in making these (microscopic) pictures, I will give

as briefly as possible the formula and a description of the instrument by which they are made". Pike's process was similar to that of Dagron.

The first studio in America to be devoted exclusively to the production of novelty microfilms (and also to offer a course in which prospective microfilm technicians might learn the technique) was that of John H. Morrow, located at 14 John Street, New York City. "Mr. Morrow obtained his instructions from head-quarters, that is, from *Dancer*, Manchester, and *Dagron*, Paris". His studio is described in the editorial of Septmber 1866 by Edward Wilson referred to above. In view of its historical importance to Americans we quote from that editorial:

"Mr. Morrow has opened his rooms and is prepared to do any amount of work, which, from a number of specimens we have seen, is most excellent and charming. We were shown opera-glasses, watch charms, finger-rings, breastpins, eye-glasses, knives, canes, penholders, pencils, pipes, porte-monnaies, &c in great variety. By close examination, a little sparkling dot would be found, not as large as the head of a pin. Looking through these, we would see most wonderful beauties, such as masonic certificates, college diplomas, the Lord's prayer, portaits of fifty people, all distinct, or it might be the Cabinet, our own picture, or that of some other distinguished individual! The most beautiful application of this elegant process is to finger-rings. No matter what color the stone may be, it may be so ground as to be used for a microscope for viewing the picture of the one you love best or the least.

"Mr. Morrow took great pains to show us his whole modus operandi of printing, &c, which was very novel and interesting. . .

"The process is very simple and easy, and the instruments used low in price, and not complicated. Fifty-six pictures have been made in one minute by a girl working six instruments at one time. Mr. Morrow's terms are reasonable; and he comes to us highly recommended as to reliability by other parties in New York, who are well known to our readers. This beautiful application of photography ought to be extended, and we hope it will. Mr. Morrow is now manufacturing largely for Messrs. Gurney and Son, and others, in New York".

The year 1867 is chiefly notable for an extensive description of the microphotographic process included in the second edition of Sutton's "Dictionary of Photography"; nine years before, the first edition had brushed the process aside as childish.

Dancer, having continued his researches in other branches of science, at this time was interested in the application of the microscope to investigations of respiratory diseases and to the broader problems of public health. In 1867 he read a paper before the Manchester Literary and Philosophical Society on the microscopic examination of flue dust.

Dagron, meanwhile, was exhibiting at the Universal Exposition of Paris in 1867, and again won honorable mention for his microphotographs. Once again the Dagron exhibit was productive of admiring articles in the scientific press. One such article refers to "those astounding 'microscopic photographs' invented by M. Dagron, whereby he places a monument in a ring and a portrait on a pinhead". The popularity of his microphotos is attested later on in the same article, which remarks that "during the Exposition some merchants, who carried their display of wares about their necks, followed the passerby in order to sell him, for 50 centimes, a *View of the Exposition in a penholder!* Actually, it is a tiny lens, as large as a pin, set in a penholder and enclosing a view of the Palace from the Champ de Mars. How strange and admirable an epoch is ours, when one must consider banal and pass by without stopping before marvels just because they have been in existence for perhaps a dozen years!"

About a year later, in 1868, Dancer read a second paper on public health before the Literary and Philosophical Society; this time he dealt with the solid particles to be found with a microscope in Manchester's smoke-laden air. It may be expected that such papers were received with something less than paeans

of congratulations from the factory owners and mill superintendents of Lancashire; such gentry felt that discussion of public health was bordering on the new Marxian socialism arising in Europe or, worse, smacked even of Voltairean skepticism regarding this best of all possible worlds.

Finally, in keeping with the evolution of the animated lantern slide so popular in the Sixties, a French photographer named Anguier described (in June 1868 — and patented the following year) a process in which microphotos attached to a pair of Brewster magnifiers mounted in rubber could be given the illusion of related movement through pressure applied to the rubber mount.

* * * * * *

Meanwhile, war clouds once again were scudding across the skies of Europe.

Wilhelm I, king of Prussia, had placed Otto von Bismarck in the Chancellor's chair while General von Moltke became the Army's Chief of Staff. The power-hungry Prussian General Staff chose a group of rival German states as the luckless guinea pigs to prove the theories of Karl von Clausewitz, and modern warfare was born. Responsibility for the struggle, later known as the Seven Weeks War, is now placed directly on the shoulders of Bismarck.

Napoleon III, of France, fresh from his attempt to set up a satellite empire in Mexico, viewed the rising star of Prussianism with envy; with characteristic imprudence he determined single-handedly to eclipse that star. An excuse for aggression was readily manufactured, an excuse so flimsy that a disillusioned Frenchman was caused to describe his own nation as "a people of firebrands, always ready to overthrow the map of the world".

The formal, or professional, aspect of the Franco-Prussian War which resulted, beginning in the confident rattle of the

Emperor's sabre on July 19, 1870, ended in the crash of French hopes on the first day of September, six weeks later, when the Emperor and his army surrendered at Sédan. From this day on, until the final armistice five months later, the French war effort was a blundering but heroic struggle by amateurs — amateur militarists, amateur statesmen and Republic builders.

The isolation of Paris by the besieging Prussian armies was a crushing blow to French pride. It is not difficult to imagine, even in these days of helicopters and point-to-point radio, the sense of imprisonment suffered by the inhabitants of the Capital, to say nothing of more serious privations. To re-establish communications with the guerilla forces fighting in the provinces became more than a duty with the people of Paris. It became an obsession, and every suggestion for relieving the blackout of news, however impractical, was eagerly tried. Into the rarified atmosphere of pseudo-scientific planning soared the schemes to provide Paris with news from the world outside.

Chapter 5

FLIGHT FOR FRANCE

"I propose to send a letter off by the balloon which will leave in the morning. The idea seems to be that the balloon line is a success. I wish there could be a balloon to come in, for this absence of all intelligence from the outside world is becoming quite unbearable".

—*Entry for September* 26, 1870: *Diary of the American Minister to France.*

It is seven o'clock, just six minutes before sunrise on the morning of November 12, 1870. The siege guns of the encircling German armies have been in full cry since dawn, and a column of smoke in the Southeast already marks a new fire in the beleaguered city. Throughout the hours of the night there has been a bustle of activity in the great train yard of the Gare d'Orléans in the Montmatre section of northern Paris. Working under a battery of locomotive headlights men struggle with a pair of enormous, half-filled balloons. The monstrous shadows move erratically over the roadbed and rails, the Prussian guns boom with monotonous regularity, and the weird cries of the hurrying workmen echo from the walls of the cavernous station. There is little wonder that the scene reminds many spectators of Gustave Doré's new and popular woodcuts depicting Dante's seven circles of Hell.

Over in a corner the Postmaster General, Dr. Rampont-Lechin, repeatedly consults his watch with a worried air, raises a moistened finger to test the westerly wind, and impatiently turns to speak in a low voice to Eugène Godard, director of the balloon service. The crowd hovers near, expectant and anxious, awaiting the arrival of the intrepid men who are braving Bismarck's threat of court-martial and a spy's death to cross the German lines in a drifting balloon. A little apart from the crowd stand several officials of the newborn Third Republic: Béchet, Chassina, Hervé-Magnon, and a clique of budding bureaucrats. Beyond one catches a flash from the heavily be-medalled and be-braided admirals in charge of the defense of Paris; Challié and Fleuriot de Langle.

And now a thrill passes through the crowd, as the first four passengers arrive: MM. René Dagron, photographer; Albert Fernique, professor of engineering; Jean Poisot, artist and son-in-law of Dagron; and Gnocchi, asssitant to M. Dagron. These men are to leave in the balloon called *Niepce.*

Almost immediately the passengers of the second balloon, named the *Daguerre,* step into the lighted area: MM. Nobécourt, expert on the care of messenger pigeons; Pierron, engineer; and M. Pierron's dog, who was to attempt to return to Paris through the German lines with messages secreted in his collar.

A quick greeting is exchanged between the passengers and the two sailors who have been instructed by M. Godard to pilot the balloons: Jubert of the *Daguerre,* Pagano of the *Niepce.*

By now the mail cart has arrived with four bags (nearly six hundred pounds) of mail, which are speedily placed in the basket of the *Daguerre,* already packed with some of Dagron's cameras and chemicals. M. Nobécourt climbs into the nacelle

with the crates of thirty homing pigeons which he has brought, Pierron hoists aboard his dog and himself, and the *Daguerre* is ready to take off.

Across the court Dagron and his party are attempting to fit themselves into the basket with thirteen hundred pounds of M. Dagron's photographic equipment. Last to clamber aboard are the two student aeronauts, who — by the way — have never taken a balloon trip before.

Anchor and dragline are checked at the last moment as they hang on the sides of the nacelle, and Pagano and Jubert exchange signals. The balloons, held by a small army of volunteers selected from the crowd of onlookers, balance themselves on the breath of the breeze, oscillating with the regular swing of a pendulum. Each sailor drops a little ballast to steady the craft; then, at exactly ten minutes past nine, they cry out the magic words, "CAST OFF!"

The balloons rose easily and were quickly borne in an east-north-easterly direction by the brisk breeze; within a half-hour they had been lost to view by the watchers at the railway station. Arriving over the Prussian lines at eleven o'clock at an altitude of about 2600 feet the balloonists were astounded to find themselves in the midst of a lively fusillade from the ground. Although more than a score of balloons had preceded them since September 23, German rifle fire had been ineffectual at such an altitude and one or two aerial travellers had had the unmitigated effrontery to release visiting cards to float down to the enraged and impotent Germans below.

Chancellor Bismarck, however, had not contented himself with merely threatening aerial blockade runners with death; he had also turned to Krupp, already famous as the greatest armament makers in all Europe. Krupp's answer was simple: take the long-range, breach-loading artillery rifles which had

changed artillery history at the Battle of Sadowa four years before and remount them for vertical as well as horizontal traverse. There seems to be some evidence as well that rocket barrages against the balloons were used experimentally.

The *Niepce* and the *Daguerre* were the first to encounter the new German anti-aircraft barrage. An efficient Prussian fifth column operating within Paris had informed the enemy of the imminent departure of equipment and pigeons to establish a photographic airmail system between Free France and the besieged capital. The wind was westerly. The German artillery was waiting.

As the hostile shells whistled about their frail and highly inflammable craft, the travellers hastily set about jettisoning ballast. Here the supreme example of amateurish lack of foresight was discovered; the sand ballast in the *Niepce* had been hung in bags made of cotton cloth so rotten that the bags had broken under the constant movement of the nacelle of the balloon, and more than seven hundred pounds of sand was strewn over the floor of the basket and the chests of photographic equipment. In frantic haste the five men scooped the ballast overboard with a shallow plate until the balloon had risen beyond artillery range.

Unfortunately, however, the *Daguerre* was hit before she could get away, and the occupants of the *Niepce* watched with heavy hearts as she descended giddily, carrying Jubert, Nobécourt, Pierron, the dog, the pigeons, the mail, and the rest of M. Dagron's equipment. She struck, modern warfare's first flak-riddled casualty, on the wall of a farm at Joissigny, near Ferrières in the suburbs of Paris. Almost immediately a troop of hard-riding Uhlans came galloping up to seize the prize and her cargo.

By 1:30 P.M. the *Niepce* had reached an altitude of about five thousand feet. The voyagers decided, in view of the fact

that little ballast remained, to land; yet, not knowing whether they were over Prussian — or French-held territory, the need was manifest to descend rapidly in order to give the pursuing German cavalry as little time as possible to arrive. Without a landing crew to seize the trailing ropes the landing was precarious; the anchor could find neither hedge nor bush to grasp, the wind was strong, and the balloon lay over and travelled more than a mile at breakneck speed, the basket dragging and bumping along the ground.

The situation was desperate: five men and over a half ton of equipment crowded in a space four by five-and-a-half feet were tossed about like the ivories in an agitated dice box. Poor Fernique was caught with his neck between crossed ropes and saved himself only by a frenzied effort; Gnocchi, the photographer's assistant, had a similar experience and was saved from serious injury only by a fortuitous rolling of the basket. Dagron, a man well past his youth, was endangered by a swinging box when his son-in-law saved him from a broken head. All were indeed grateful when the cotton fabric of the balloon was so whipped and buffeted that the gas escaped from the tattered shreds and the basket finally came to rest.

The adventurers had little time for self-congratulation, however. Peasants, hurrying toward the fallen balloon, informed them that they were inside the Prussian lines, near Châlons-sur-Marne (main staging area at the time for Prince Frederick Karl's army in Eastern France), and that the Uhlans would arrive at any moment. They soon learned that they were but a few miles from the River Marne and the little city of Vitry-le-François (later an important rail junction and prime target of General Patton's 1944 American army); in less than five hours the *Niepce* had travelled about 125 miles across hostile territory. (See map, Fig. 7).

The five men had barely time to dress themselves in peasant

caps and blouses given them by the French patriots and to load their equipment on two little farm wagons before the Prussians arrived and seized one of the wagons. The Prussians trained their rifles on the group of Frenchmen standing before them, but did not open fire, and before they could determine which men were from Paris the now unburdened and revitalized remnants of the balloon claimed their attention. During the ensuing excitement the Parisians escaped, taking the second wagon full of equipment with them.

At this time M. Fernique separated himself from the party and set off alone for the hamlet of Coole, on the stream of the same name; the others were to meet him there later with the wagon. As it turned out, however, Fernique travelled six days alone through enemy-held territory. His mission was to establish various means of communicating with Paris from the provinces, and in Auxerre on the Yonne River, he and Professor Bart (secretary general of the prefecture and holder of the Chair of Physiology at the Sorbonne) undertook to organize a subfluvial messenger service. They placed dispatches in spherical containers designed to float just below the surface of the river and placed these in the River Yonne, to drift downstream to the Seine and thus to Paris. This, and all such later attempts proved fruitless, for the Germans intercepted the floats upstream from the Capital; the enthusiasm for the system by the French is illustrated by the fact that the day after the Prussians withdrew their nets following the armistice some 800 of the containers floated into Paris.

Meanwhile, Dagron, Poisot, Gnocchi, and Pagano, unable to reach Coole, wound up in the even smaller settlement of Vesigneul, farther downstream. Here the four men were hidden in the attic of the mayor's house, while the baggage, with the exception of one chest, was concealed in the barn. Mme. Songy, the mayor's wife, hid the credentials of the party in her

pocket. The fugitives had barely reached the attic when a pursuing detachment of Uhlans stumbled upon the stray chest and left for reinforcements, whereupon Mayor Songy loaded the Parisians into his carriage and took them to the home of the priest of Fontaine-sur-Coole, a village some fifteen miles from the famous cathedral city of Rheims.

Since the rectory recently had been made the billet of Prussian officers the fugitives obviously could not remain there, so they proceeded with a recommendation from the priest to a fellow curate at Cernon, a village of about 165 inhabitants even farther north; there the travellers arrived at ten o'clock in the evening, hungry and exhausted by what probably had been the most exciting day in their lives.

Even here they found no rest, for a group of peasants who brought their equipment from Vesigneul warned them that the Prussians were at that very moment in hot pursuit. So the weary party moved on in their flimsy peasant garments, chilled to the marrow by the cold autumn night, and arrived in Bussy-Lettrée at five o'clock on the morning of Sunday, November 13. Armed with a letter from Cernon's curé they were welcomed by the schoolmaster, who thawed them out with a good fire and procured carriages for them.

That same day the adventurers entered the slightly larger village of Sompuis, having made nearly a complete circle in their flight through the countryside since leaving the balloon. In Sompuis they found that M. Fernique had passed through the night before, and by the kind offices of the postmaster they were conducted across the boundary between the departments of Marne and Aube to arrive at the village of Dampierre at one o'clock on the morning of November 14.

In Dampierre they were befriended by a physician, who put them in touch with teamsters possessing Prussian permits to transport wine. The ever-ingenious Dagron loaded his

cameras, plates, and chemicals into empty wine casks and the party travelled on to Nogent, then up the Aube valley toward Pougy and Vendeuvre.

On the last leg of this trip they were warned that the enemy was requisitioning horses and wagons in Vendeuvre, so they turned back and travelled downstream until they came to the ancient and pretty little city of Arcis, at the head of navigation of the Aube. Since they could not pass inspection of the wine casks at the city line they left them in a little village outside the city, while the men went on into Arcis. They found the hotels filled with Prussians, and M. Dagron was accosted in the dining room of his hotel by a Hanoverian horse-doctor who felt out his sympathies by offering to bet 100 *thaler* that Paris wouldn't hold out another fortnight; the Frenchman let wisdom rule his pride, however, and successfully avoided the trap.

The wine cask camouflage had now served its purpose, and during the night the equipment was repacked in baskets and boxes. Since all roads leaving Arcis were patrolled after seven o'clock, the Parisians left at four in the morning for Troyes, and arrived without incident. In obedience to some unspecified demand of the police, Pagano the Sailor was left behind in Arcis.

Troyes, a very ancient city of about 40,000 population, located on the left bank of the Seine in the middle of a vast and fertile plain proved a difficult place to obtain horses and wagons, but these were finally rounded up with the assistance of a patriotic merchant of the city. The party, now reduced to three by the absence of Pagano, left Troyes at three o'clock on the morning of Thursday, November 17, and travelled southwest to Saint Florentin, in the department of Yonne. Turning west here they came upon a body of Prussians, whom they had been trailing by twelve hours, bivouacked in the tiny

settlement of Avrolles, which the Prussians had just taken. This hamlet was at the forks of the road leading to Sens, site of the beautiful Gothic windows now incorporated into the architecture of The Cloisters in New York's Fort Tryon Park.

While M. Dagron and his assistant were being held by the German sentries, M. Poisot was demanding permission to travel on from the major in charge of the detachment. This gentleman had retired to a nearby commandeered chateau for the night, and was adamant in his orders that no one was to leave Avrolles before the Prussians, who were scheduled to advance at eight o'clock the following morning. At this same time a series of rifle shots heard in the distance caused the sentries to look upon their captives with suspicion, and they were about to set upon the Frenchmen when Dagron's son-in-law returned from the major, and the travellers were allowed to take their wagon to a nearby farm.

As it had begun to rain they sought refuge in the barn, but the Prussians ordered them out. Their suspicions now fully aroused, the sentries insisted on inspecting the contents of the wagon, saying the Frenchmen surely had come from Paris with contraband goods. The trio denied this and stoutly maintained they had just arrived from Troyes, and demanded the presence of an officer to attest their story.

Time passed as the disputants bickered, and the officer, comfortable enough in town, did not arrive. Meanwhile, the local teamster returned to the barn for his lantern, whereupon the sentries, thinking their captives had violated their injunction, went to the barn to investigate. During their absence the Dagron party was able to cross the road to a tavern, where they spent an uneasy night under the distrustful eyes of Prussian officers. By this maneuver they escaped but they also lost several additional pieces of equipment important to their mission.

On the following morning, Friday, November 18, the Prussian forces moved off toward Joigny; the vanguard had hardly cleared the village when it made contact with the defending French forces in Brienon. The skirmish, of course, closed that road to the Dagron party, so they took off across fields in a torrential downpour, alternately pulling and pushing their clumsy wagon across plowed and sodden ground. Before long they arrived at a good sized village on a raised plateau which was held by French patrols; it was Mont-Saint-Sulpice, and marked the end of their six days of travel through occupied territory.

In Mont-Saint-Sulpice, however, an unexpected challenge beset them. Instead of being hailed as brave and patriotic men who had risked their lives to bring their equipment through the enemy lines they found the authorities regarding the entire tale of their adventures with a jaundiced eye. The result of these suspicions was that they received a recommendation which was, to say the least, lukewarm in tone.

Still traveling south they crossed the Serein River and entered Seignelay, where they were forced to undergo several indignities and to see their baggage searched, all because of the wording of the permit from Mont-Saint-Sulpice. They left Signelay as soon as possible, accompanied by a military guard, and soon arrived in Moneteau, where they were better received. By eleven o'clock that night they had arrived at the home of the prefect in the large and very ancient city of Auxerre, seat of government for the department of Yonne; here at least they were expected, having been described by M. Fernique, who already had left.

After a short rest the three men travelled on through Nevers and on to Tours, seat of the fighting French government under the leadership of Léon Gambetta. They arrived at Gambetta's home at eight o'clock on Monday morning, Novem-

ber 21, just nine days after leaving the Gare d'Orléans in Paris. Here they were reunited with M. Fernique; here also a little later they were to learn that a forest ranger in the woods at Ferrières had been able to save one mailbag and six pigeons from the wreck of the *Daguerre;* he had used the pigeons to convey to Paris six identical messages: "Large blue and yellow balloon fell at Joissigny. Prussians captured balloon, voyagers. Have been able to save a mailbag and six pigeons". The twenty-four remaining pigeons were captured and used on two different occasions by the Prussians to send false and disheartening information to beleaguered Paris.

Chapter 6

NEWS-HUNGRY PARIS

Saturday, November 26: Being eaten with diversified seasoning, are horses, dogs, cats and rats . . . Rat roast, rat ragout, rat en pâté, rat barbecue, rat salad, minced rat it is all the same. Supreme consolation: statistics show at present 25 million rats in Paris. . . "

"A new pigeon brought 500 private dispatches today. . .".

—*Journal du siege,* 1870

Tours had not been the original objective of Dagron and Fernique. They had set out for Clermont-Ferrand, a city some thirty miles southwest of Vichy and destined to became one of the most important synthetic rubber centers on the continent during the much later Nazi occupation of France. The sequence of events leading to this change is a story of bickering and petty jealousies among the founding fathers of the Third Republic.

The siege of Paris began little more than a fortnight after Napoleon III and his proud French army had surrendered at Sedan. On September 4, 1870, a one-eyed, thirty-two year old anti-imperialist politico named Léon Gambetta had arisen in the Hotel de Ville in Paris to proclaim the dissolution of the Empire and the birth of the Third Republic. His demand for continued resistance against the Prussians struck a responsive

chord in the hearts of the humiliated French people, and led to the creation of a Fighting French movement. Militiamen sprang to arms in the provinces, and the streets of the capital began to bristle with barricades.

On September 16 the first Prussian patrols arrived before Paris; two days later the last mail train left the city for Brest at 3:00 P.M. In a single day's action the enemy troops took, almost without suffering any casualties, three positions which completely neutralized the effectiveness of the forts of Montrouge, Vanves, and Issy, and brought more than a fourth of Paris within the range of hostile gunfire. The coming events of the fall of the Maginot Line, and the whole aspect of fluid attack versus static defense most emphatically cast their shadows before — seventy years before — on the suburbs of Paris that momentous September day in 1870.

The sudden success of the attacking forces, giving the lie to the bland assurances of their officers, struck terror in the hearts of the defenders of the capital. Observation balloons under the command of Lieutenant Colonel Usquin were rapidly run up, and the balloonists had a ringside seat at the crucial battle. We have the description of an eyewitness to follow:

"Clinging to their cars the aeronauts of the captive balloons could observe with an indignant eye, while unable to do anything about it, the episodes of that fateful day. They saw the Prussians forming their columns of attack, and our soldiers in zouave uniforms throwing away, after a mere sham resistance, their guns in order to flee more rapidly. With their eyes the aeronauts followed these cowards, who ran through the doors of houses spreading alarm, until the indignant populace stopped them".

The inner circle of the city's defenses held, however, and the Prussians settled down to consolidate their positions and to contact their effecive fifth column inside the city. Frederick the Great had emphasized the role of the spy in wartime operations, and the Prussians now boasted of having 30,000 spies

throughout France. To eliminate the possibility of coordination of attacks by the garrison of Paris with those of the armies in the provinces, all communications were cut. Railroads, roads, watercourses: all, right down to the last footpath, were closed to the French.

The besiegers even dredged the telegraph cables from the bed of the Seine, and the last telegram from outside arrived at noon, September 19. An attempt was made to smuggle mail through in the carts of hucksters; that not a single cart was able to penerate the lines is hardly surprising. From September 20 to October 30 some eighty-five postmen tried to slip through the lines with messages concealed in hollowed coins, in specially prepared artificial teeth, and even in incisions made in the skin. Of the eighty-five only eight were able to deliver their messages, while fourteen were captured and at least one was shot by the Prussians.

On January 11, 1871, toward the end of the siege, five individuals contracted with the post office to attempt to run the blockade by means of the famed Paris sewers and quarries; later, one of the volunteers using the same route for General Trochu, military governor of Paris, fell into a pool of filth in the sewers and met a horrible death by suffocation.

Some days before the city had been encircled, however, the Jardin des Plantes had received a thousand homing pigeons from the prefect of the Département du Nord and from the Chamber of Commerce in Lille, together with a hundred more from the citizens of Laval. The husband of Mme. Anaïs Ségalas, a well-known poetess in her day, is credited with suggesting these be used for communication with Unoccupied France.

Since the useful load a pigeon can carry is no more than about a thirtieth of an ounce the messages were necessarily limited and reserved for official use. To secure a greater chance

of delivery each message was duplicated in the loads of ten pigeons, and in this manner some four hundred pigeons were released in Paris to fly home during the siege.

Enthusiastic French aeronauts were not long in pressing forward the advantages of leaving Paris by free balloon. In addition to the sentiment and tradition afforded by the balloon corps organized under Colonel Coutelle during the First Republic in 1794, these arguments may be summarized as: frequent breezes to carry the craft over the lines of siege; carrying capacity sufficient for a half-ton of passengers and cargo; a readily available gas supply from the illuminating gas mains of Paris.

Enthusiasm in the government was great, and permission was given for a trial. Nevertheless, the project almost died at the very outset when the first take-off was attempted in an ancient balloon which had been badly overloaded in the careless optimism of the pilot. Wilfrid de Fonvielle, ardent aeronaut and writer of popular science articles, rescued the program from abandonment by persuading the Director of Postal Service, Dr. Germain Rampont, to make a second attempt, this time with a more modern balloon and a competent aeronaut.

On the orders of Dr. Rampont the observation balloon located at Place Saint-Pierre, in northern Paris, was cut loose at 7:45 A.M. September 23. Carrying about four hundred pounds of mail the balloon, christened the *Neptune,* immediately drifted off to the westward.

As he passed over Versailles the owner and pilot, Claude Jules Duruof (who less than a year later was to be on trial for his life for participation in the Communard uprising of 1871), was greeted by an angry hail of bullets from the ground. Utterly contemptuous of the rifle barrage the aeronaut let float down upon the heads of the besiegers a series of greeting cards addressed to King Wilhelm, Queen Augusta, and Prince

Bismarck, taking care to show the fashionable touch of the boulevardier by turning down a corner on each card before releasing it. What effect such impertinence may have had upon the future Kaiser and his queen is uncertain; the "Iron Chancellor," however, is reported to have given way to choleric rage and to have ordered that any persons captured while attempting to cross the lines of siege by air would be considered spies and summarily shot.

The *Neptune* did not expose M. Duruof to any such peril but floated off northwestward. By eleven o'clock it had covered seventy-five miles and landed in unoccupied territory near Craconville, Department of Eure.

Encouraged by the success of the *Neptune* a second balloon, the captive stationed at La Glacière on the Boulevard d'Italie, slightly larger than the *Neptune* and bearing the name *Ville de Florence,* took off the second day after Bismarck had received his greeting from Duruof.

Piloted by the aeronaut Gabriel Magnin and chartered by the Ministry of Public Works, the *Ville de Florence* carried one passenger, a M. Lutz, in addition to three hundred pounds of mail, including a printed appeal from Victor Hugo to the Prussian soldiery, a bit of wartime propaganda "couched in the well-known flowery rhetoric" of the poet.

After the successful trips of these two pioneer balloons the postal authorities were convinced of the value of a regular balloon service, and the world's first successful airmail system was established in a decree issued by Dr. Rampont on September 26. In this decree private mail was divided into two classifications:

> Letters, which must weigh no more than a seventh of an ounce and whose postage was fixed at twenty centimes; and

Postal Cards, which must weigh no more than a ninth of an ounce and measure no more than 2 by 4¼ inches, but which could be sent anywhere in France or Algeria for ten centimes.

At about this same time contracts were signed with two groups of aeronauts to build for the government new balloons to replenish the dwindling supply. Workshops were set up in the temporarily empty railway stations of Paris and the government was soon receiving an average of one new balloon each day. In all, over sixty balloons left Paris during the nineteen weeks of siege; altogether, they carried 164 passengers and 23,670 pounds of mail, or somewhere between two and a half and three million dispatches and letters.

Even so, the balloon-post was but a half-solution to the reopening of French communications, for the traffic was all one-way. Floating back on a whimsical breeze in a free balloon to hit a target only six miles in diameter was too difficult a task to be practicable, although the Tissandier brothers, enthusiastic amateur aeronauts, made two such attempts. Under the auspices of the august Academy of Sciences a blimp, the *Duquesne,* was built and left Paris in January, with three sailors laboring mightily at hand-powered propellers; turn as fast as they might, the sailors caused the *Duquesne* to deviate from the course set by the prevailing winds not one whit, for this was still thirty years too soon for the successful accomplishment of directional flight.

Of the scores of aeronauts and their passengers who left the capital by balloon only five were able to return to Paris bearing messages.

Many were the schemes brought forth for returning news to the invested city; some of them bordered on the fantastic. At three o'clock on the morning of January 15 an inventor named Delente left in the balloon *Vaucanson* with the govern-

ment's blessing to build a boat he had designed for crawling, submerged, along the bed of the Seine. In the words of a contemporary, "M. Delente did not return in his submarine boat; the armistice, which made his efforts unnecessary, perhaps was one of the reasons".

In addition to such schemes as man-powered blimps and riverbottom tractors, several projects were advanced for the carrying of dispatches into Paris by other than human messengers. The efforts of Albert Fernique to establish a floating dispatch service have been touched upon already, and a contract was signed on December 6 between the Postal Authority and MM. Venoven, Robert, and Delort for a similar project. Postage was to be fixed at one franc, with each letter limited to the weight of a seventh of an ounce; of the amount collected for postage the concessionnaires were to receive eighty percent, half of their share to be paid upon consignment of the mail to the river, the other half upon receipt in Paris.

Next to be attempted was the use of messenger dogs in an effort to run the blockade. M. Pierron, as we have seen, left with his dog on November 12, only to be captured by the enemy when the *Daguerre* was shot down. M. Hurel, another proponent of this system of dog-delivery, was offered 200 francs for each delivery which reached Paris within forty-eight hours after being consigned to the hollow collars of the dogs; he left with five shepherds on the *General Faidherbe* on January 13, and released his canine couriers some twenty-five miles outside Paris.

An ironic circumstance was the cause of the downfall of this scheme: food had become so scarce in the beleaguered city that nearly every stray dog soon found its way to the stew kettles, and the government was obliged to warn the hungry populace of the expected arrival of the four-footed messengers.

Once again the Prussian intelligence scored a beat, and not one of the dogs ever reached the city.

Encouraged by the success of the flights from the Jardins des Plantes to Lille and to other home lofts in Unoccupied France, homing pigeon enthusiasts early began a campaign for the use of their birds in bringing dispatches into Paris. Long years of tradition bolstered their argument, for the use of homing pigeons to carry messages is as old as the time of King Solomon; again, in 43 B.C., Marcus Brutus, within a year after his assassination of Caesar, used courier pigeons to notify the Roman consuls that he was besieged, in Mutina (now Modena, in northern Italy) by Marc Anthony; this provided a very close parallel for purposes of argument in 1870.

More recently, that father of modern journalism, James Gordon Bennett, in cooperation with the Baltimore *Sun* and the Boston *Daily Mail,* had set up in 1838 a regular pigeon dispatch system which eventually reached from Halifax to Washington; Bennett's pigeons were responsible for many a news scoop and were maintained as an auxiliary service by his New York *Herald* for many years after the invention of the telegraph. In Europe, furthermore, it had been the custom of the captains of French boats crossing the Channel in the late 1830's to release a pigeon bearing news of safe arrival as soon as the steamer came under the cliffs of Dover.

The instantaneity and greater reliability of the electrical telegraph had nearly eliminated the use of the pigeon for any but racing purposes by 1870, however, and the siege found Paris with but twenty lofts in existence, all privately owned. The members of the pigeon fanciers society "L'Espérance" apparently were the first to offer their birds to their country's service, although the rival society "Roitelet" was not long in following their example. Vice President van Roosebecke and

Secretary Dérouard, both of "L'Espérance", presented their plan to General Trochu, military governor of Paris, about September 22.

General Trochu showed great interest in the plan, and sent the gentlemen to Dr. Rampont, Postmaster-General. Dr. Rampont also was interested, and the second balloon to leave Paris, the *Ville de Florence*, carried three pigeons, all of which returned with notices of the successful completion of the flight, arriving in the capital within two and a half hours after the balloon landed.

Impressed by this experiment, Dr. Rampont placed M. Chassina, who was postal director for the Department of Seine, in the post of administrator of the pigeon post, while M. Dérouard, as owner of one of the city's largest lofts, was charged with overseeing the loft installations, reception of incoming birds, etc. Several of the members of both societies left Paris for the Provinces to oversee the handling of the birds as they arrived by balloon, and M. van Roosebecke himself was assigned to the headquarters of the government's provincial delegation in Tours.

One of the members, M. Nobécourt, was travelling with Pierron and his dog on the ill-fated *Daguerre* when she was shot down, and he was taken prisoner along with most of the thirty pigeons he was carrying. As we have seen, however, a forest ranger in the woods at Ferrières was able to save one mailbag and six pigeons from the wreck before the Prussians could get them, and he used the birds to convey to Paris six identical messages.

Before the siege was over the balloon post had carried between three hundred fifty and four hundred pigeons out of Paris, although only about seventy returned. M. Dérouard himself supplied 53 birds to the Postal Authority, of which all but two were lost.

A number of factors influenced the number of messenger birds returning; some were captured before reaching Free France; some, no doubt, had been insufficiently trained, for most of the seventy birds which returned belonged to but a handful of lofts; some fell victim to the cold weather, for December was several degrees colder than normal and birds were seen to drop even while circling over the place of departure; some pigeons were claimed by the Prussian infantry, who emulated the rival editors of James Gordon Bennett by shooting down the couriers; some fell prey to trained falcons brought in from Saxony to hunt down and kill the messengers: Nineteenth Century jet fighters flashing down on Piper Cubs.

Nevertheless, the pigeons did get through, sending news-starved Parisians clamoring after the tired birds as they flew on to the home loft, and sending feature writers into reams of lyric prose demanding the inclusion of the pigeon on the city's heraldic arms. The pigeons themselves were given such pet names as "Gladiator" and "Daughter of the Air", and some were apparently at least as well known to the besieged Parisians as the heads of the government.

Because of the relatively few pigeons able to make the trip successfully some means had to be found to increase the number of dispatches each bird could carry. The obvious solution was the abbreviation of the dispatches, with subsequent transcription to a form easily read by the recipients in Paris.

The initial means of achieving this was simple: all official messages were collected in Tours from all parts of free France; here expert penmen reduced the texts to a numerical code written in minute characters on light-weight paper. As might be expected, these manuscript texts were often lacking in legibility because of the penman's desire to achieve the ultimate in minuteness.

Discontent with the shortcomings of the coded manu-

script dispatches was evident right from the start and a number of persons, apparently simultaneously, thought of reducing the original uncoded messages by photographic means; at any rate, there were many who received credit for the suggestions, among them a M. Lacoin who had been involved in the River Seine floating dispatch schemes, Professor d'Almeïda of the Scientific Committee of the Ministry of Public Instruction, and Charles Barreswil, a celebrated chemist who was in Tours supervising the evacuation of school children from cities threatened with siege.

Regardless of who might receive credit for the idea of making photographically reduced reproductions of the dispatches, there is no doubt that Professor d'Almeïda and his colleague, Professor Albert Fernique, secured the cooperation of the Scientific Committee of the Ministry of Public Instruction in instituting research on the photographic problems involved.

M. Fernique started this research at the Lycée Corneille, but soon was transferred to the Ministry of Finance, where the minister, Ernest Picard, outfitted him with a special laboratory. The apparatus used by M. Fernique had been invented and was furnished by René Dagron, who enjoyed a reputation as the outstanding microphotographer in Paris.

After Fernique had tried making his microcopies of dispatches on thin paper, and then on excessively thin sheets of mica, Dagron came forward to offer him the use of the Dagron process, which was based on the use of a stripping film of collodion, a very light, very tough material, flexible, transparent without blemishes, and impervious to water.

Afer experimental use of the Dagron process had overcome the technical problems of the photographic post M. Picard suggested to Fernique that he travel by balloon to the provinces and there set up a dispatch service. Fernique, however, pointed

out that M. Dagron was far better fitted to handle the photographic work, and suggested that the post be offered to him. This was done; Dagron accepted, and Fernique was allowed to go along to assist Dagron, as well as to handle other assignments for the government, of which the floating dispach service was one.

Meanwhile, after some talks which were repeatedly broken off by false but persistent rumors of an armistice, a contract was drawn up by Dagron, Fernique, Picard (representing the Treasury), and Rampont (representing the Post Office). On November 12 Dagron, Fernique, and their assistants left Paris in the balloon trip described in Chapter 5.

Chapter 7

THE PHOTOGRAPHIC PIGEON POST

"Microscopic copies of despatches and valuable papers and plans might be transmitted by post and secrets might be placed in spaces not larger than a full stop or a small blot of ink".

Encyclopaedia Britannica, Eighth Edition, 1857

No sooner had Dagron and Fernique arrived in Tours and presented their agreement with the Postal and Treasury Departments than they found themselves the subjects of hot denunciations by the members of the government's Delegation in Unoccupied France. As mentioned before, Léon Gambetta, whose guests the travelers now were, had proclaimed the birth of the Third Republic early in September. Useful as he was as a catalyst for the hitherto unorganized republican fervor, Gambetta proved to be somewhat less than perfect as an administrator in the new government. It was not long before the clique of more experienced helmsmen of the French ship of state found it desirable to give their vociferous and colorful colleague a captain's gig of his own to steer. Accordingly, Gambetta, as Minister of War and the Interior, left Paris on October 7 to head the French Delegation, which was seated at Tours. In characteristis style, he named the balloon which took him over the

lines of siege the *Armand Barbes,* drawing an obvious comparison between himself and the famed revolutionist of the Second Republic.

Before leaving the capital Gambetta had secured the appointment of his protege, François Frédéric Steenackers, to the post of Director of Telegraphic Lines. Steenackers, a forty-year old Belgian who had been a member of the Chamber of Deputies, turned over the Paris headquarters to his assistant, a well-known physicist named Mercadier, and left for Tours shortly before Paris was surrounded.

Soon after Gambetta had arrived in Tours Steenackers prevailed upon him to combine all government communications in the Provinces under himself, and on October 12 Steenackers became Director General of Postal and Telegraphic Services for the Delegation. Inflated with his new importance Steenackers began to assume more and more authority until he reached the point of ignoring completely the orders and recommendations emanating from his superiors in Paris. Feelings reached such a state of tension that months later Steenackers was accused of insubordination by a Commission of Inquiry into the Acts of the Government of National Defense. Thus were planted the seeds of a controversy which was to recur until the end of the century in the memoirs of persons even remotely connected with one side or the other.

At the time that Fernique was experimenting with microphotographic reproduction of dispatches in Paris the Delegation, too, was rushing forward with its plans for a more efficient pigeon-borne postal service. Steenackers ordered an amateur photographer named de Lafollye, who also was serving as Inspector of Telegraph Lines for the Department of Indre-et-Loire, to organize a photographic message service. This service was established under a Delegation decree of November 4, 1870, eight days before the *Niepce* left Paris. De Lafollye

lost no time in hiring a portrait photographer named Blaise to do the actual photography. Speed was essential, for the Delegation well knew of the central government's plans and they wished to beat the Dagron party to the punch.

Under the initial program set up by de Lafollye, dispatches addressed to Paris from all parts of Unoccupied France were collected at Tours. Here clerks were employed to copy by hand all messages in large clear letters, arranging them in such a way as to leave no waste space. The sheets so produced were pasted to large cardboard sheets which, in turn, were fastened to wooden panels some thirty-nine inches high by twenty-five inches wide. The panels then were turned over to Blaise, who photographed them (apparently with a standard portrait camera) on a 40 x 50 mm. (1½ x 2 inch) wet plate; his developer was a formula commonly used by portrait photographers of the time: pyro and iron sulfate.

From these negatives a paper contact print was pulled and turned over to de Lafollye. This gentleman proofread each dispatch to Steenackers, reading the reduced text by means of a hand lens. After approval, the photographic prints were turned over to a cousin of Steenackers, Georges Blay, who was in charge of attachment of the dispatches to the messenger pigeons and then releasing the couriers as near Paris as the front lines permitted. In Paris the birds, of course, went directly to their home lofts. Here their owners removed the goose quill containers from the messengers and delivered them to the military governor of Paris, General Trochu. When the messages had been transcribed on regular telegraph forms marked "Reçu par pigeon" by copyists using magnifying lenses the copies were delivered to the addressees by regular telegraph messengers.

It was soon apparent that the large number of messages pouring into Tours from other parts of France would rapidly overwhelm the facilities of the pigeon post, and Blaise increased

the size of his negatives and prints to 40 x 75 mm. (1½ x 3 inches), which was about the limit in size a pigeon could carry. Then, on November 9, Blaise began sensitizing his printing paper on both sides, thus doubling the number of messages printed on each sheet.

Scattered on the sheets and mixed in with the manuscript dispatches were occasional clippings from the newspaper, *Moniteur universel*. The clarity of reproduction in reduced form of these clippings, as compared with that of the manuscript portions of the sheet, suggested the setting of all messages in type before photographing. As a result, the Mame printshop in Tours, publisher of the *Moniteur* and several other refugee papers, was called upon to print the dispatches. Long Primer typeface was chosen, and the format was three closely printed columns on vertical sheets measuring about nine inches wide and thirty-five inches high. Blaise copied two of these sheets on each negative, so that each sheet of duplitized printing paper carried the contents of four of the printed sheets. The first pigeon carrying a load of these prints arrived in Paris on November 14, bringing 22 dispatches, totalling over a thousand words. Blaise worked for the Delegation until December 11; in a little over a month's time he was able to supply 59 duplex prints, holding a total of 9,800 private messages, to de Lafollye for transmittal to Paris.

It was on November 18, while Blaise and de Lafollye were struggling to keep up with the flood of dispatches being turned over to them, that Fernique arrived in Tours to investigate the report of a pigeon post conducted by the photographers of the Delegation. He talked with both Steenackers and Gambetta, and informed them that he and Dagron had been commissioned by the central government to establish an independent venture in Clermont-Ferrand.

At this Gambetta and Steenackers became incensed, and

declared that they considered this an attack on the authority of the Delegation. They forbade Fernique to go to Clermont or even to send off a pigeon reporting the crisis to Paris, threatening him with court-martial and a traitor's death if he disobeyed. And they sent a telegram to Dagron, who that day had reached Auxerre, ordering him to report immediately at Tours instead of Clermont-Ferrand.

Once he had arrived at Tours Dagron, together with Fernique, set about pressing the advantages of the Dagron process before Steenackers. Again and again they argued that the ratio of reduction (much greater than in the Blaise process), the much lighter weight of the collodion, the greatly lessened exposure time (two seconds, as against two hours), and the transparency of the Dagron films would be the only practicable solutions of the photographic bottleneck which was growing worse day by day.

Steenackers and de Lafollye were, as might be expected, not a bit enthusiastic about turning their project over to the newcomers. They attacked through the contract signed between the photographers and the Ministries of Communications and Finance. In this document, Articles 7 and 10 allowed Dagron 25,000 francs and Fernique 15,000 to cover the risks of the voyage. In case of death an annual life pension of 3,000 francs was to be paid to each of the widows. For the actual work, Articles 5 and 9 provided that the partners were to receive 15 francs for each thousand letters or characters reproduced: at the agreed daily minimum production of 10,000 dispatches, each containing from fifteen to twenty words, this amounted to at least 15,750 francs per day for the enterprise.

De Lafollye denounced the contract as a blatant example of war profiteering and pointed to the patriotism of Blaise, who had been working at a flat rate of 50 centimes per word. What deLafollye did not point out was that, had Blaise been

able to reach Dagron's output of 10,000 dispatches per day his gross receipts would have been greater than those of Dagron. Furthermore, under the Dagron system one pigeon could carry a number of messages equivalent to the load of thirty pigeons burdened with the Blaise prints.

The constant bickering over money, authority, and political ethics was so wearing that Fernique, for one, began to regret ever having agreed to undertake the considerable risks and inconveniences of the project. Dagron stood to lose even more, for while Fernique had been paid his 15,000 francs in Paris, Dagron was to receive his 25,000 francs in Tours; furthermore, in addition to having left a lucrative business behind in Paris, Dagron had lost between eight and ten thousand francs worth of equipment to the Prussians.

The Delegation could not, however, escape the fact that a steadily growing backlog of dispatches awaiting photography was piling up on Blaise. So, after more than a week of procrastination, Steenackers on November 29 brusquely ordered Dagron and Fernique to take over. By December 5, the partners already were in operation, despite their having to work with uncalibrated lenses borrowed from amateur photographers to replace those lost with the *Niepce*. In view of the staggering size of the job confronting M. Dagron it is of interest at this point to note the basic principles of his process:

Mame, the printer (later supplemented by Juliot's printshop), delivered the messages printed on transparent sheets divided into twelve rectangles 80 x 110 mm. (3¼ x 4½ inches), each rectangle containing at least a thousand characters. The photographer cut the sheet in two, so that each half, placed in a printing frame in contact with a collodion dry plate, made a contact negative of six rectangles of print simultaneously. As pointed out above, the exposure time (even under the weak December sun) averaged about two seconds.

Thirty-three such printing operations were sufficient to copy the two hundred blocks of type supplied each day.

After the glass plate negatives had been developed, fixed, washed, and dried, they were cut with a glass cutter so that each block of type was on a plate by itself, not much larger than a modern 3¼ x 4 inch professional lantern slide plate. Dagron reports that a single semi-skilled worker could easily print, process, and cut apart the two hundred such negatives in a day's time and still have time left over to sensitize the next day's batch of dry plates.

As each small plate was made available it was placed on the reproduction frame in the copying camera. This camera had twenty short-focus lenses so arranged that, at a single exposure, they produced twenty separate positive prints of the negative, each print no larger than a twenty-fifth of an inch. By use of a device resembling a modern repeating camera back, a second series of the miniscule prints was made on the same plate, thus producing forty separate prints from a given negative in two exposures. The camera was a modification of one used by Dagron some years before.

After the plate bearing the forty microfilm prints had been processed, the collodion was stripped from the glass with the assistance of a castor oil bath, a modification of the process in use by American photographers nearly two decades before. The tiny prints then were cut apart and assembled with similar prints of other type blocks on a small, clear piece of collodion film for transmission to Paris.

This process had been successful — if painstaking — when applied in the well-organized Dagron laboratory in Paris. In the crude workshops of Tours, impure chemicals, unskilled operators, and the strain of working with inspectors openly hostile to the enterprise made it a difficult matter. De Lafollye, who still reserved to himself the right to inspect all results,

reported with easily discernible pleasure that he rejected a considerable number of films after Dagron had passed them. He did, however, state that the causes of rejection were, first, the use of loaned lenses replacing Dagron's precisely calibrated lenses; and second, occasional uneven shrinkage of the film due to faulty chemicals used in coating the plates with collodion. For this and other reasons apparent below, Dagron adopted the recommendation of the Inspector to modify his process. This entailed the direct copying of the sheets supplied by the printer (each of which now contained nine, twelve, or sixteen rectangular blocks of type) on a dry plate 36 or 38 mm. wide by 60 mm. long (roughly equivalent to triple-frame 35 mm. film today). Thus was obviated the necessity of cutting similar prints apart and assembling them with others on a separate base.

Since the reduced photographs now were negatives instead of positives they were contact-printed on another plate, whose collodion layer bearing the image then was stripped from the glass. The reduction ratio was so great, even under this procedure, that every film thus produced bore from three to four thousand messages of twenty words each. The films weighed but one twentieth of a gram each; so light and compact were they that a pigeon released on January 21, 1871 actually carried twenty-one such films, or a total of between sixty and eighty thousand messages. Just as in the case of later applications in the V-Mail and Airgraph systems of World War II, delivery was guaranteed. From each negative held at Tours a print was made and sent out by each pigeon leaving for Paris until acknowledgment of receipt came from the capital by balloon post. Before the end of the siege Dagron had, in less than eight weeks of work, copied 470 printers' sheets and had furnished the Delegation with more than two and a half million dispatches representing 115,000 separate messages.

As it worked out de Lafollye would hand over all official dispatches printed by Mame, arriving not later than noon each day; by 5 P.M. Dagron would have returned to him ten copies of each sheet. The mornings apparently were devoted to the reproduction of private messages and also the large quantity of money orders which poured in for payment in Paris. Dagron often copied and sent complete editions of the *Journal officiel;* occasionally a copy of *The Times* of London, reproduced by the London Stereoscopic and Photographic Company, was consigned to the Paris-bound birds.

The quality of Dagron's work, exalted in the most glowing terms on one side, yet condemned as of the poorest quality by writers on the opposite side of the political fence, would seem to be questionable on the basis of contemporary written evidence. Fortunately, however, a few original Dagron films have come down to us, some of which went through the siege, others dating from right after the end of the siege. One of the latter is reproduced in this monograph. In 1936, tables published by Robert C. Binkley of the Joint Committee on Materials for Research of the Social Science Research Council and the American Council of Learned Societies showed that another film which survived showed a far superior degree of legibility than was obtained on films made with modern materials in the best of modern microfilm cameras when operated by experts at similar ratios of reduction. The weight of modern evidence would, therefore, indicate that Dagron's use of collodion, plus his careful workmanship, produced microfilm which not only was most amazing in the days of our grandfathers but is worthy of our utmost respect today.

Several additional specimens of original Dagron microfilms of this period turned up in England as this book was in press. A paper by Dr. G. W. W. Stevens, of Kodak, Ltd., Research Laboratory, Harrow, England, on

an editorial and microscopical interpretation of these and other existing specimens, appears in the *Proceedings* of the Eighth Annual Convention of the National Microfilm Association, 1959.

As an example of the efficiency of the pigeon post itself we have the case of the same René Dagron.

To overcome the difficulties caused by impure chemicals Dagron ordered a consignment of pyroxylin (nitrocellulose) from the supply house of Poulenc and Wittman in Paris. The order was sent off by a pigeon released on January 18 near the front lines at Sainte-Marie, near Poitiers; twelve hours later the order was in Paris, 185 miles away.

The order was filled and left the capital aboard the balloon *General Bourbaki* on the night of January 20. The balloon landed near Rheims in enemy-held territory at 5:00 A.M. and was burned to prevent its falling into Prussian hands. The aeronaut, Theodore Magnin, set off with his cargo of chemicals and on January 24 delivered the consignment to Dagron's studio. Enthusiasts proudly noted that peacetime telegraph and railroad service would have provided no speedier delivery.

As the microfilm dispatches were delivered to de Lafollye they were tightly rolled and placed in a goosequill which previously had been drilled at each end; silk thread, passing through the drillholes, attached the quill to one of the bird's tail feathers. The pigeon's wing was stamped with waterproof ink giving the destination and other information.

Once the films had arrived in Paris they were turned over to M. Mercadier, whom Steenackers had left in charge of the telegraphic authority in the capital. Mercadier, and his colleague Cornu, carefully soaked the fragile films in a weak solution of ammonia until they unrolled and became limp. Next the films were dried and mounted between glass. This glass sandwich was placed in the slide carrier of one of several enlargers designed and constructed by the famous optician and

photographer, Duboscq-Soleil. Because this was more than eight years before Edison perfected the incandescent lamp, illumination necessarily was furnished by a carbon arc, which derived its power from storage batteries. The films were projected on a screen in a darkened room. Before the screen sat four scribes, (later, under the veritable barrage of Dagron films, increased to ten and finally to sixty-seven), who performed by hand the laborious job of copying each dispatch on a telegraph blank.

Toward the end of the siege Cornu and Mercadier were able to improve upon this method by substituting a sheet of sensitized paper for the screen, producing direct photographic enlargements. Even so, the quantity of incoming messages necessitated the full-time employment of seven photographic technicians for making the enlargements, despite the fact that only five of the last hundred pigeons released in the provinces got through with their messages.

Despite this amazing record of production of microfilms by Dagron and his staff, all was not smooth sailing. Trouble with impure chemicals has been mentioned, as has the lack of properly calibrated lenses (the two lenses loaned him differed in their focal lengths by a full two inches). Then, just as his staff had begun to get the feel of the job, the Delegation abruptly informed him on December 11 that it was moving to Bordeaux. At midnight, December 12, he and Fernique arrived in the latter city and three days later the reproduction of dispatches recommenced, not to be interrupted again until the Armistice.

Dagron and Fernique left Tours so precipitately that they had to leave behind the staff they had so painstakingly formed and trained. Alarmed now by the backlog of dispatches inherited from Blaise, and by the four days of lost production during the move from Tours, unable to form a new staff of

comparable size without further sacrifice of time, the partners made at this point the change from the original Dagron process to the modification urged by de Lafollye; within a few days they had eliminated the entire backlog of messages and were never henceforth behind in their commitments. So rapidly did they overcome the stack of dispatches accumulated by the printers that de Lafollye was moved to import extra printers "in brigades" from Tours, Toulouse, and the Midi; eventually a corps of lithographers was brought in to help out the typesetters.

Although M. Dagron had offered to reproduce gratis all official dispatches in each day's batch before he started on the lucrative private messages, Steenackers and de Lafollye continued to attack his agreement with Ministers Rampont and Picard. Finally, on December 31, Dagron signed what today we would call a renegotiation contract with the Delegation. Under the terms of the new agreement all work done in the past would be paid for at the rate of 150 francs per block of messages (as compared with 180 francs under his original franchise); work done from January 1 to 15 was to bring the photographers 90 francs per block, and all subsequent work 60 francs, or one-third the figure promised in the contract signed in Paris.

There seems to be some disagreement on how Dagron fared under this new contract. According to his family he barely broke even considering the sums of money he had spent since leaving Paris; according to de Lafollye he was able to make 52,000 francs gross profit, ten percent of which he paid to Fernique. The friends of Dagron advanced his cause in the government at home, however, and the Minister of Public Instruction was ordered to award a high school scholarship to each of the photographer's two sons.

After the siege was lifted through the capitulation of Paris on January 28, 1871, both Dagron and Fernique found

themselves so exhausted by the fatigue of their labors and the unpleasant controversy with the Delegation, that they were prevented by illness from returning home at once. Fernique finally arrived in the capital in the middle of February, but Dagron did not see his laboratory again until the middle of April; even then he had to undergo a further convalescence.

Chapter 8

THE PASSING OF DANCER AND DAGRON

"Simpson, in England, has called attention to the fact that . . . the substance of books filling entire halls, when reduced by microscopic photography, can be brought within the compass of a single drawer".

—Vogel, H: "Chemistry of Light", 1874

The Paris to which Fernique and Dagron returned in the Spring of 1871 was far different from the Paris of a year earlier. Gone were the elaborate salons and the fashionable soirees of Napoleon and the Empress Eugénie. No longer did the supercilious officers from Saint-Cyr promenade in the Champs Élysées and maneuver their troops of cavalry and battalions of infantry — personified as charging bottles of red wine and long rows of *biscottes* on the tablecloths of the sidewalk cafes. And for good reason.

For the battle of Paris had been fought by the little people. While the rich had been able to buy elephant, camel and yak meat from the Jardin des Plantes ("15 francs a pound, 40 francs for the elephant's trunk"), it was the *sans-culottes* who went out to the market day after day to buy "a well-fattened rat for 50 centimes, a scrawny one for 40", and lived to recall that "thanks to strong seasoning this Parisian game animal is not absolutely disagreeable". It was the little people who had

manned the barricades, the tatterdemalion, ragamuffin *canaille* who had seen their country imperiled and betrayed by "the educated, the intelligent, the wealthy, the refined". And now it was these same little people who manned the new barricades, in the Spring of 1871, to forestall the return of the politicians from Bordeaux and Versailles.

This popular uprising, sparked by non-Marxist Socialists, but called by the name of Communard, lasted from March 18 to the end of May and resulted in the death of 6500 Communards with the imprisonment of nearly forty thousand more. Smashed by the forces of the new government, the *prolétaire* of Paris was bitterly antagonistic to the institutions of the rich and the bourgeoisie.

Having had a taste of the fury of the mob, the guardians of vested interests took immediate steps to protect these interests from the further ravages of civil unrest. It was at this moment that René Dagron returned to the capital.

There were few in Paris who had not heard of the marvelous work done by Dagron in the provinces. Thus, when he proposed to the Government that he be allowed to safeguard the records of the budget bureau by microfilming the Register of the National Debt, he at least could command an audience. Nevertheless, there is no indication that this proposal — or a similar one made later by the optician Fleury-Hermagis to microfilm the manuscripts of the National Library — was adopted during the emergency. If the Government would not heed his advice, however, there were others who would. An insurance company fell in with his plan, and shortly afterwards Dagron made a microfilm copy of their policies, rate cards, and other records. This project, in 1871, surely is the first application of microfilm in securing the records of commerce, an application which today has assumed staggering dimensions.

Meanwhile, Dagron was not neglecting his publicity program. Mindful of the way the pigeon post had captured the imagination of the populace he published, within the first eight months of his return from Bordeaux, no less than seven magazine articles and two booklets on his role in re-establishing communications during the siege. Copies of the microfilm dispatches (both originals and simulations of originals) were placed on sale and distributed far and wide; a few are extant in the United States today. As a tour de force, Dagron experimented with very high reduction ratios and in August 1871 he reproduced 130,400 printed letters and characters (equal to 65 pages of a book of this size) in a microfilm image one-fiftieth of an inch square; contemporary accounts reported perfect legibility of the image under high magnification. Fame, however, notoriously is fickle, and Dagron no less than Dancer soon found the novelty of microfilm wearing thin.

During the Seventies Dancer's health and financial condition had been steadily deteriorating. He contracted glaucoma in both eyes, and his business began a decline which continued until he and his wife were destitute. Having put one son through college and raised seven other children, Dancer and his wife Elizabeth lived quietly in their modest home at 11 Greenhill Street, Greenheys, Manchester. Always a lively and impulsive man, fond of reading and yet popular for his parlor tricks when at a social gathering, Dancer found it difficult to adjust himself to the inactivity and the encroaching darkness imposed by his condition. The older members of the Literary and Philosophical Society had not forgotten their colleague, however, and they raised a few hundred pounds to help tide the aged couple over their declining years.

In 1884 Dancer, aware of the interest which might one day be shown in his work, dictated a part of his autobiography

to a granddaughter. The work was never published — nor even finished, for that matter — and remained in manuscript form in the family.

Finally, on the twenty-fourth of November, 1887, the tall, sparsely built old Victorian died, and was buried two days later at Brooklands in Cheshire. His loyal friends in the Society once more came forward and attempted — in vain — to secure a small civil pension for Mrs. Dancer. She, however, survived her husband by less than sixteen months and died March 5, 1889, at the age of seventy.

As for Dagron, he disappeared from the public eye for years at a time, and was forced to continue to operate his studio up to and into his eightieth year. It was not in the nature of either man to give up his normal habits and convictions during times of trouble, and in 1873 Dagron, in company with two other photographers, was granted a French patent on a microfilm viewer especially designed for the use of Army staff officers. This viewer, as well as a modification patented in 1875, was offered as a solution to the problems of all officers in the field: the weight and bulk of a map portfolio; the difficulty of keeping a map flat in a high wind; the stickiness of contemporary lithographic inks; the reading of microcopies of secret orders and reports.

The viewer was constructed to hold a large number of map microphotos for viewing by means of a microscope or for projection by lamplight on the wall of a tent or command post. Later a device for making enlarged paper prints from the microcopies was added, and still later a camera lucida for sketching those military detail drawings known as map overlays. The microcopies used were about 5 mm. in length, and had superimposed on them a grid calibrated to the scale of the map, thus making it easy for an officer to estimate any distance with a high degree of accuracy. Later on, an entirely separate scale,

in the form of concentric circles ruled on a ground glass plate which was placed behind the microfilm holder, was introduced; this could be used in conjunction with maps of varying scales, and eliminated the necessity of carrying a supply of grids calibrated to different scales. The viewing microscope was mounted on a hinge, and could be swung away from the micro-maps. In this position, through the substitution of an eyepiece for the objective lens, it readily became a telescope. Finally, in keeping with the Nineteenth Century love of gewgaws and gimcracks, the device was so laden with accessories that its inventors could and did claim:

> "Our case furthermore contains a compass, a wind rose, a sundial, a level, and consequently in its entirety forms a regular cabinet, so that it might properly be called 'the staff-officer's topographic cabinet' ".

Leaving no adjective unturned, the patent claims suggested that, in addition to its use in military service, the viewer could be applied to the reading of microfilm copies of "scholars' charts, to instruction in general, and to commerce".

The work of Dancer and Dagron after 1852 was, as we have seen, predicated on the use of transparent bases for microfilm. There are a number of reasons for the use of transparencies, among which may be noted the greater range of contrast possible in the reproduction of light and shade, and the higher degree of resolution possible between closely spaced microscopic lines.

Microcopying with opaque-base materials did not, however, die with the obsolescence of the daguerreotype. Microphotographs on paper, on metal, and on other materials are preferred by a number of technicians at the present time, and the processes are recurrently the subject for enthusiastic books of "discovery". The terms "microprint" or micro-opaque" are usually applied to these products, as distinguished from the transparent microfilms.

One of the first published accounts of a workable method of making microprints was that of Georges Scamoni, photographer for the Russian Imperial Office in St. Petersburg. His process was described in his "Handbuch der Heliographie", which appeared in 1872, and consisted of building from a positive collodion print a silver matrix in exaggerated relief. Copper-coating this matrix by electrolysis, he obtained a relief printing plate in metal. By adapting this method to small-size photocopies Scamoni was able to produce a reproduction of a page from the German illustrated magazine *Über Land und Meer* which was but an inch in width. Once he had produced his metal printing plate it was but a further application of commercial printing technique to make a large edition, and the inventor envisaged his process as being applied to large scale production of microscopic books and (what was closer to his immediate interests) maps which could be concealed with the greatest of ease. Microprint, however, had not yet come to stay and, except for some secretive work done by Duncan Dallas, an engraver in London who experimented in producing lilliputian libraries by microprint, the process was largely ignored for several decades.

In the meantime, Dancer and Dagron both had emerged briefly from obscurity. The former became locally famous for the invention of "Dancer's top", a plaything painted with sectors of complementary colors which merged and blended as the top was spun; such tops have been commonplace now for generations of children. In 1876 Dancer read a paper before the Literary and Philosophical Society describing his 1838 experiments in the production of ozone. During the following year, when sixty-five years of age, he made an important contribution to knowledge in a treatise on his observations of the transfer and rejuvenation of soil through the agency of earthworms. This paper laid the groundwork for Charles Darwin's later

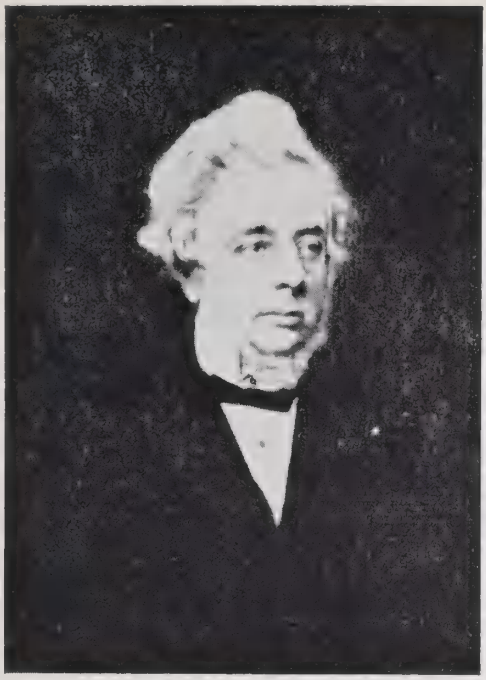


FIG. 1—John Benjamin Dancer (1812-1887), English pioneer in microphotography. Made the first known microcopy of a document in 1839.

FIG. 2. — René Prudent Patrice Dagron (1819-1900), French pioneer in microphotography. Granted first microfilm patent in 1859. Made practicable the Pigeon Post of 1870-1871. First to apply microfilm to large-scale reproduction of business records, 1871.

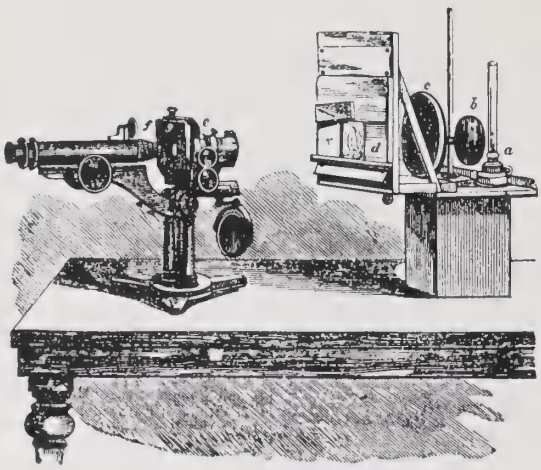


FIG. 3.—SHADBOLT'S MICROFILM CAMERA, 1856.

a: Illuminant.

b, c: Condensers.

d: Copy holder for full size negative.

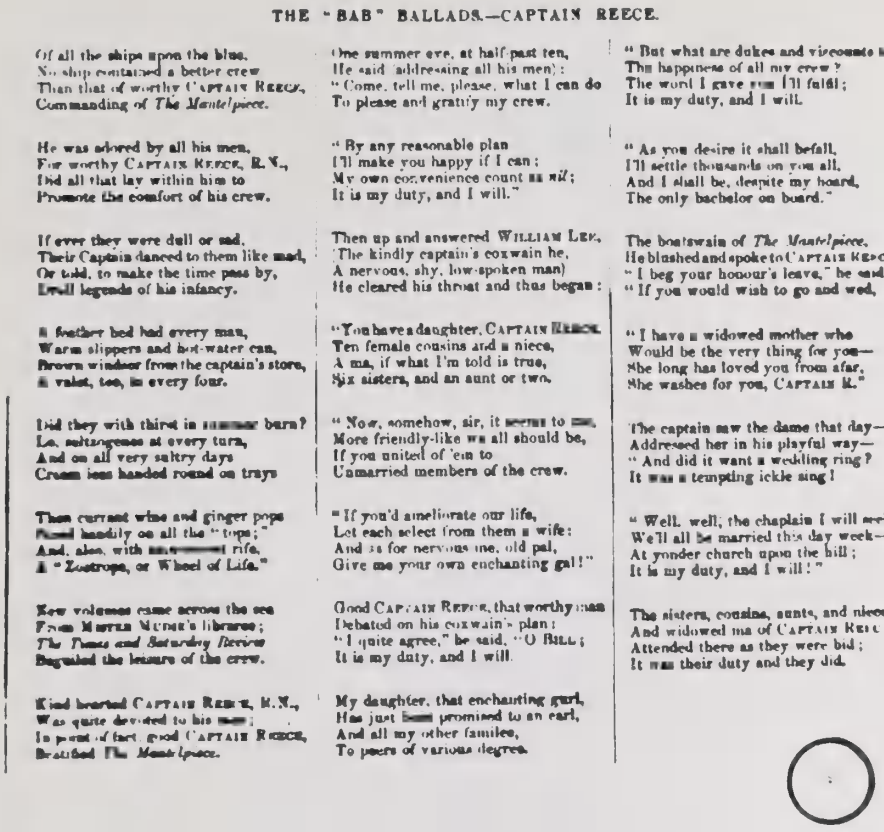
e, f, g: Camera and focusing mechanism.

e: Lens and shutter mounted on stage of microscope.

f: Microscope used for critical focusing of Lens E on focal plane G.

g: Sensitive plate mounted on stage of microscope in focal plane of Lens E.

(*From Photographic Journal*, 1857)



THE "BAB" BALLADS.—CAPTAIN REECE.

Of all the ships upon the blue,
No ship contained a better crew
Than that of worthy Captain Reece,
Commanding of *The Mantelpiece*.

He was adored by all his men,
For worthy Captain Reece, R.N.,
Did all that lay within him to
Promote the comfort of his crew.

If ever they were dull or sad,
Their Captain danced to them like mad,
Or told, to make the time pass by,
Droll legends of his infancy.

A feather bed had every man,
Warm slippers and hot-water can,
Brown windsor from the captain's store,
A valet, too, to every four.

Did they with thirst in summer burn?
Lo, seltzogenes at every turn,
And on all very sultry days
Cream ices handed round on trays

Then currant wine and ginger pops
Flowed handily on all the "tops;"
And, also, with machine-like rifle,
A "Zoetrope, or Wheel of Life."

New volumes came across the sea
From Mister Mudie's library;
The Times and Saturday Review
Beguiled the leisure of the crew.

Kind hearted Captain Reece, R.N.,
Was quite devoted to his men;
In point of fact, good Captain Reece,
Beatified The *Mantelpiece*.

One summer eve, at half-past ten,
He said (addressing all his men):
"Come, tell me, please, what I can do
To please and gratify my crew.

"By any reasonable plan
I'll make you happy if I can;
My own convenience count as nil;
It is my duty, and I will."

Then up and answered William Lee,
(The kindly captain's coxwain he,
A nervous, shy, low-spoken man)
He cleared his throat and thus began:

"You have a daughter, Captain Reece,
Ten female cousins and a niece,
A ma, if what I'm told is true,
Six sisters, and an aunt or two.

"Now, somehow, sir, it seems to me,
More friendly-like we all should be,
If you united of 'em to
Unmarried members of the crew.

"If you'd ameliorate our life,
Let each select from them a wife:
And as for nervous me, old pal,
Give me your own enchanting gal!"

Good Captain Reece, that worthy man
Debated on his coxwain's plan:
"I quite agree," he said, "O Bill;
It is my duty, and I will.

My daughter, that enchanting girl,
Has just been promised to an earl,
And all my other families,
To peers of various degrees.

"But what are dukes and viscounts to
The happiness of all my crew?
The word I gave you I'll fulfil;
It is my duty, and I will.

"As you desire it shall befall,
I'll settle thousands on you all,
And I shall be, despite my hoard,
The only bachelor on board."

The boatswain of *The Mantelpiece*,
He blushed and spoke to Captain Reece:
"I beg your honour's leave," he said,
"If you would wish to go and wed,

"I have a widowed mother who
Would be the very thing for you—
She long has loved you from afar,
She washes for you, Captain R."

The captain saw the dame that day—
Addressed her in his playful way—
"And did it want a wedding ring?
It was a tempting ickle sing!

"Well, well, the chaplain I will seek,
We'll all be married this day week—
At yonder church upon the hill;
It is my duty, and I will!"

The sisters, cousins, aunts, and niece,
And widowed ma of Captain Reece,
Attended there as they were bid;
It was their duty and they did.

FIG. 4. — ONE OF DANCER'S MICROFILMS, c. 1860.

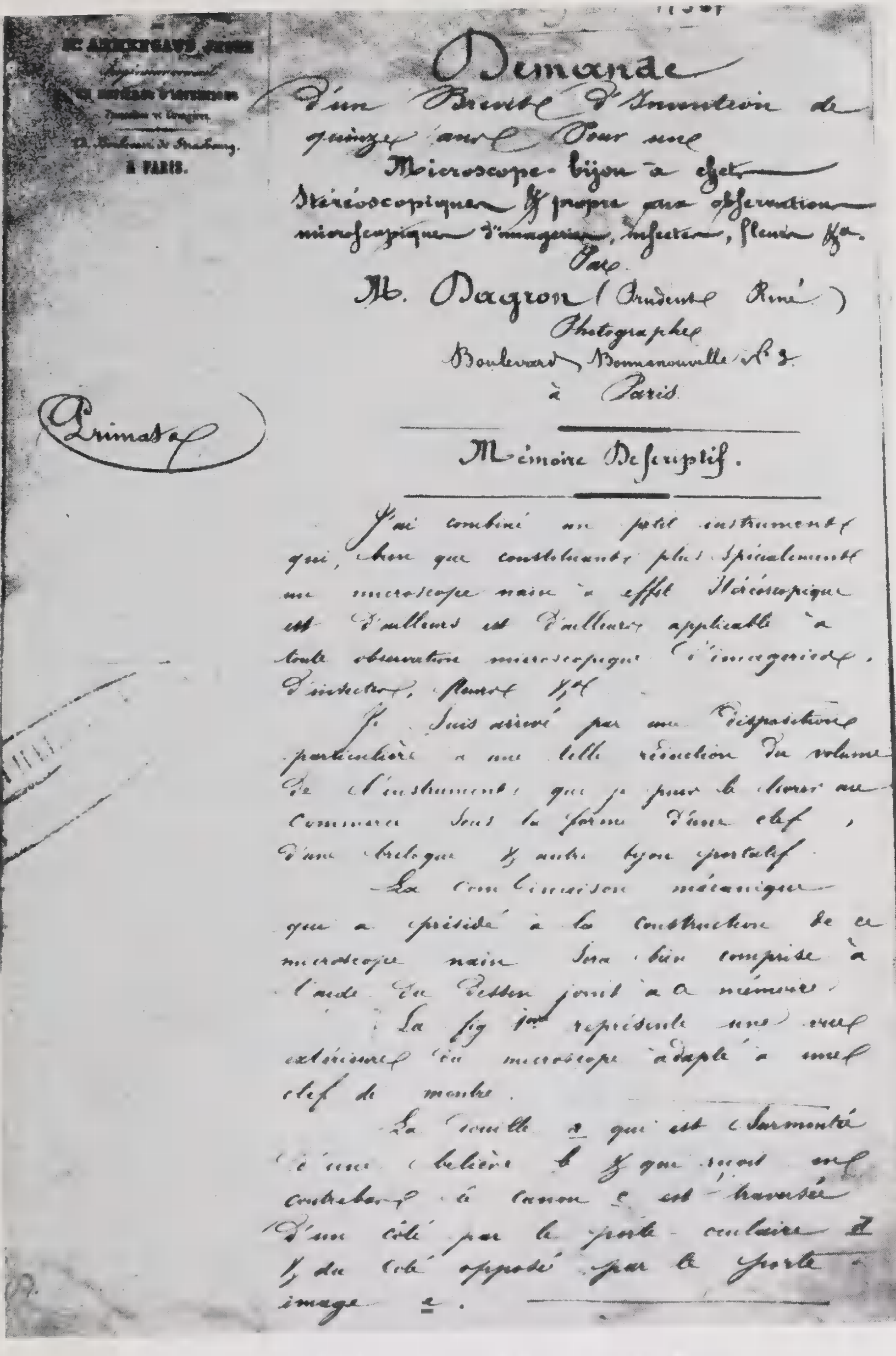
Enlargement made in 1950 by Dr. G. W. W. Stevens from an original Dancer microfilm dating from about 1860. The inset at the bottom right corner shows the actual size of the original film.

(Courtesy of the Photographic Museum, Kodak, Ltd., Harrow, England)

FIG. 5. — AMERICAN MICROFILM, c. 1855.

Enlargement at about 90 diameters from early microphotograph on a glass microscope slide; 200 portraits of the Kings and Queens of England in a space roughly 1 x 1.5 mm. in size. The mother and child in the center are Queen Victoria and probably her last son, Prince Leopold, born in 1853. Microphotographer unknown; possibly the Langenheims of Philadelphia.

(Courtesy of the American Museum of Photography)



Demande d'un Brevet d'Invention de quinze ans pour une Microscope-bijou à effet stéréoscopique propre aux observations microscopiques d'imageries, insectes, fleurs &c.

Par M. Dagron (Prudent René) Photographe Boulevard Bonne-Nouvelle N° 3 à Paris.

Mémoire Descriptif.

J'ai combiné un petit instrument qui, bien que constituant plus spécialement un microscope nain à effet stéréoscopique est d'ailleurs applicable à toute observation microscopique d'imageries, d'insectes, fleurs &c.

Je suis arrivé par une disposition particulière à une telle réduction du volume de l'instrument, que je peux le livrer au commerce sous la forme d'une clef, d'une breloque & autre bijou portatif.

La combinaison mécanique qui a présidé à la construction de ce microscope nain sera bien comprise à l'aide du dessin joint à ce mémoire.

La fig 1re représente une vue extérieure du microscope adapté à une clef de montre.

La douille a qui est surmontée d'une bélière b & qui sert de contrebas du canon c est traversée d'un côté par le porte-oculaire d & du côté opposé par le porte-image e.

FIG. 6 — THE WORLD'S FIRST MICROFILM PATENT.

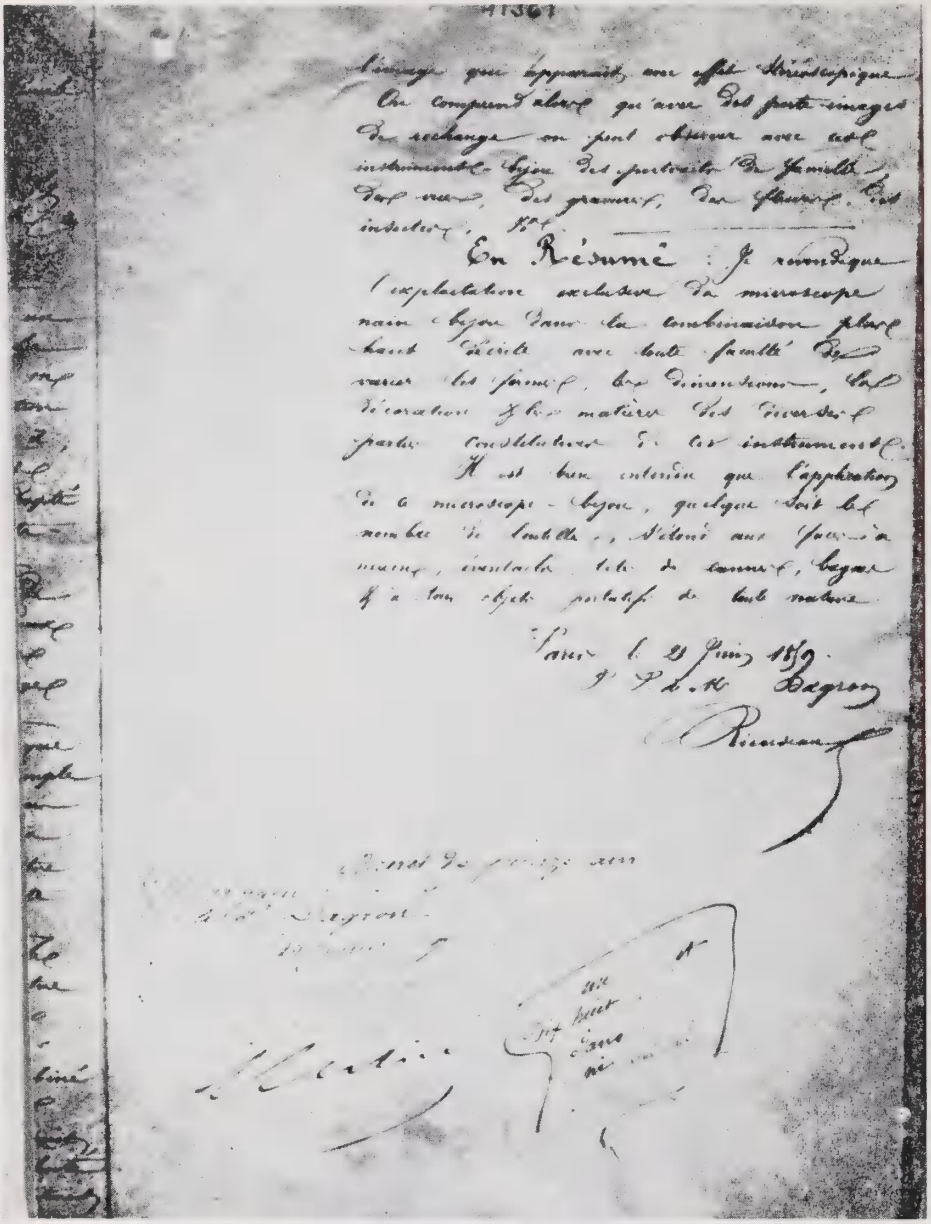


FIG. 6 — THE WORLD'S FIRST MICROFILM PATENT.

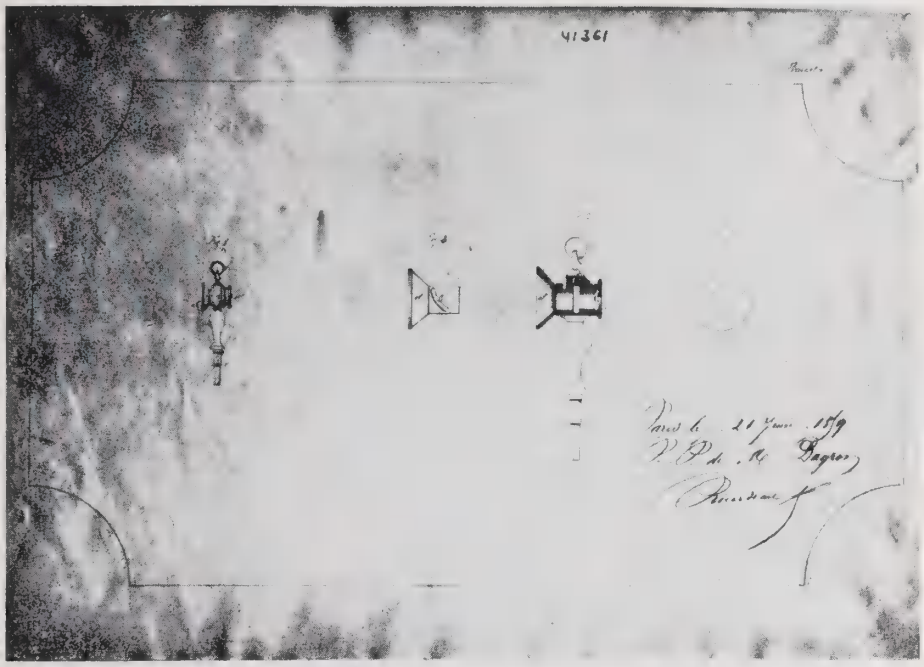


FIG. 6. — THE WORLD'S FIRST MICROFILM PATENT.

Manuscript copy of Dagron's patent (France, No. 23,115), dated June 21, 1859, on the application of microfilm to novelty items.

(Courtesy of M. René Dagron II)

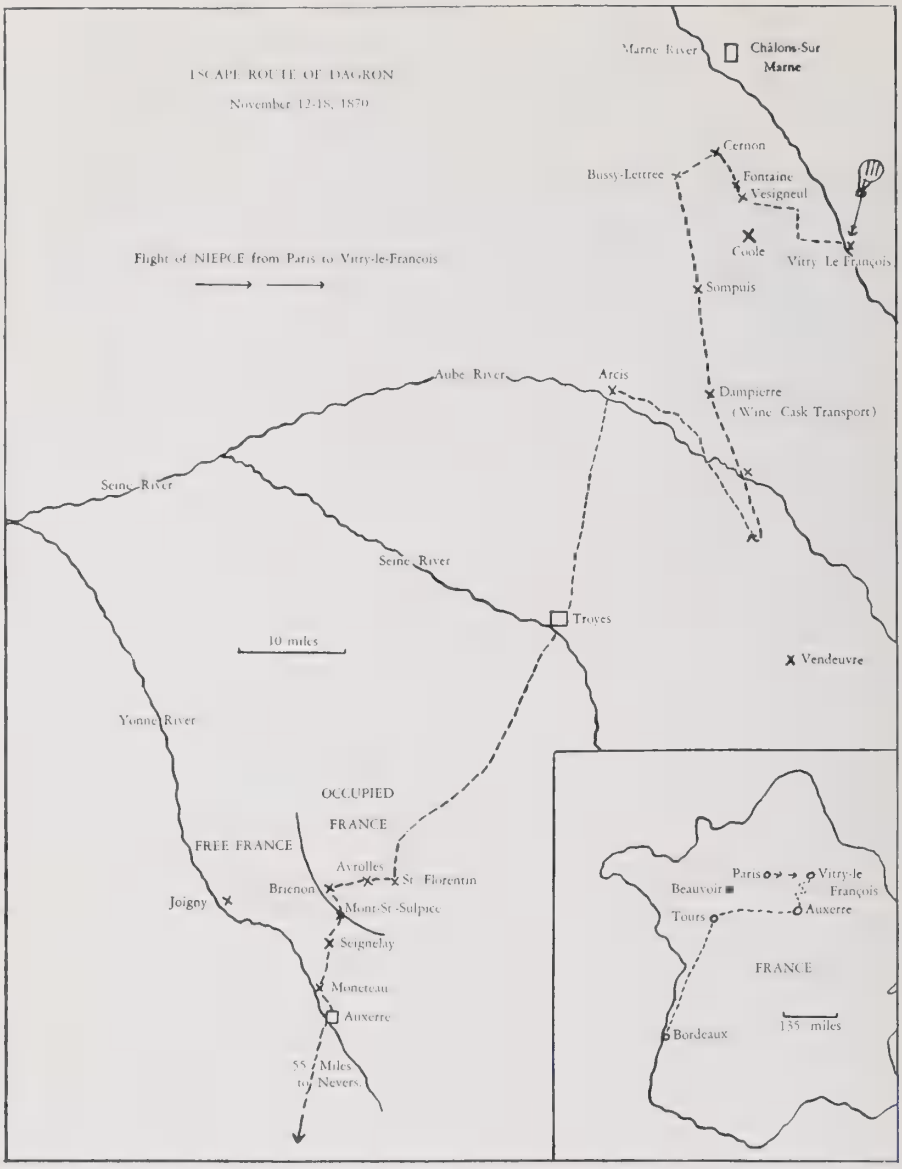

ESCAPE ROUTE OF DAGRON
November 12-18, 1870
Flight of NIEPCE from Paris to Vitry-le-Francois
Marne River
Châlons-Sur Marne
Cernon
Bussy-Lettree
Fontaine
Vesigneul
Coole
Vitry Le François
Sompuis
Aube River
Arcis
Dampierre
(Wine Cask Transport)
Seine River
Seine River
Troyes
10 miles
Vendeuvre
Yonne River
OCCUPIED
FRANCE
FREE FRANCE
Avrolles
St. Florentin
Brienon
Joigny
Mont-St.-Sulpice
Seignelay
Monteau
Auxerre
55 Miles
to Nevers.
Paris
Vitry-le
François
Beauvoir
Auxerre
Tours
FRANCE
135 miles
Bordeaux

FIG. 7

FIG. 8. — MICROFILM VIEWERS, 1864.

Novelty items of ivory embodying Dagron microfilms. The letter opener carries a viewer with a perpetual calendar on microfilm.

(Courtesy of M. René Dagron II)

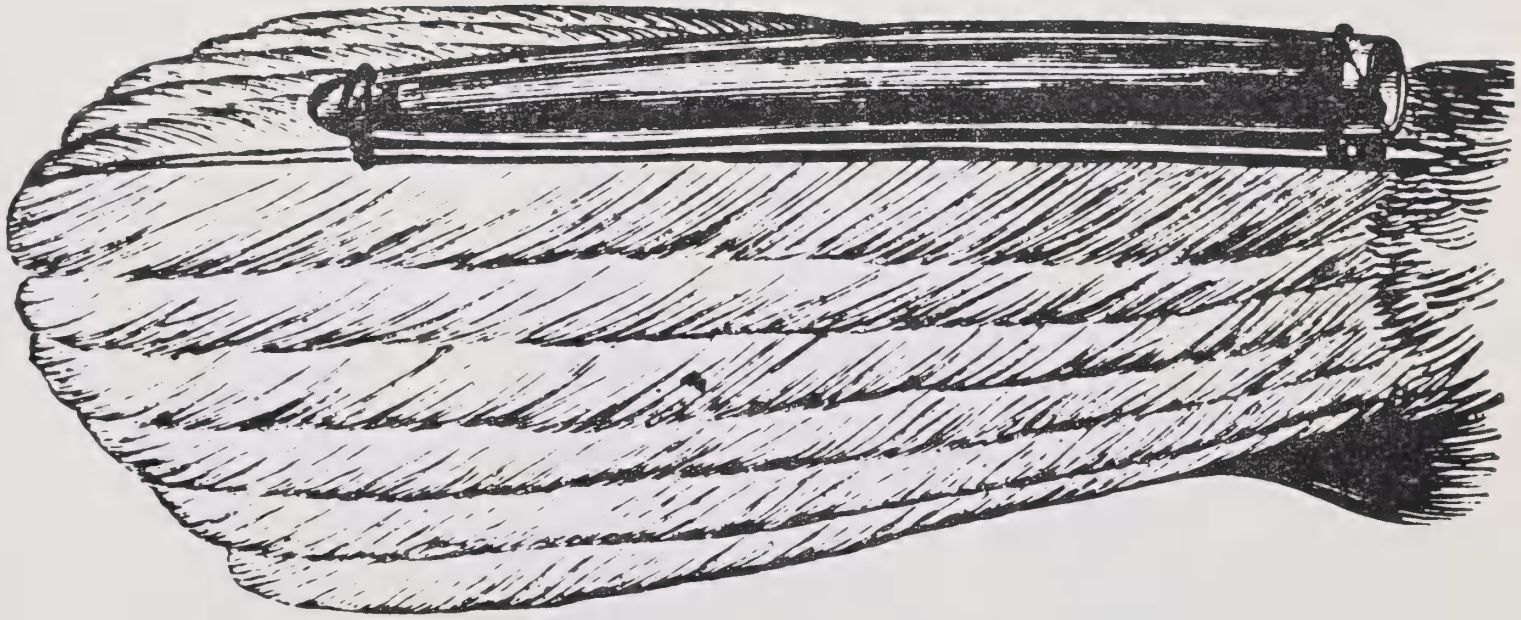


FIG. 9. — Goose quill, containing the 18 microfilms tightly rolled and tied to a pigeon's tail or wing for transmission to Paris.

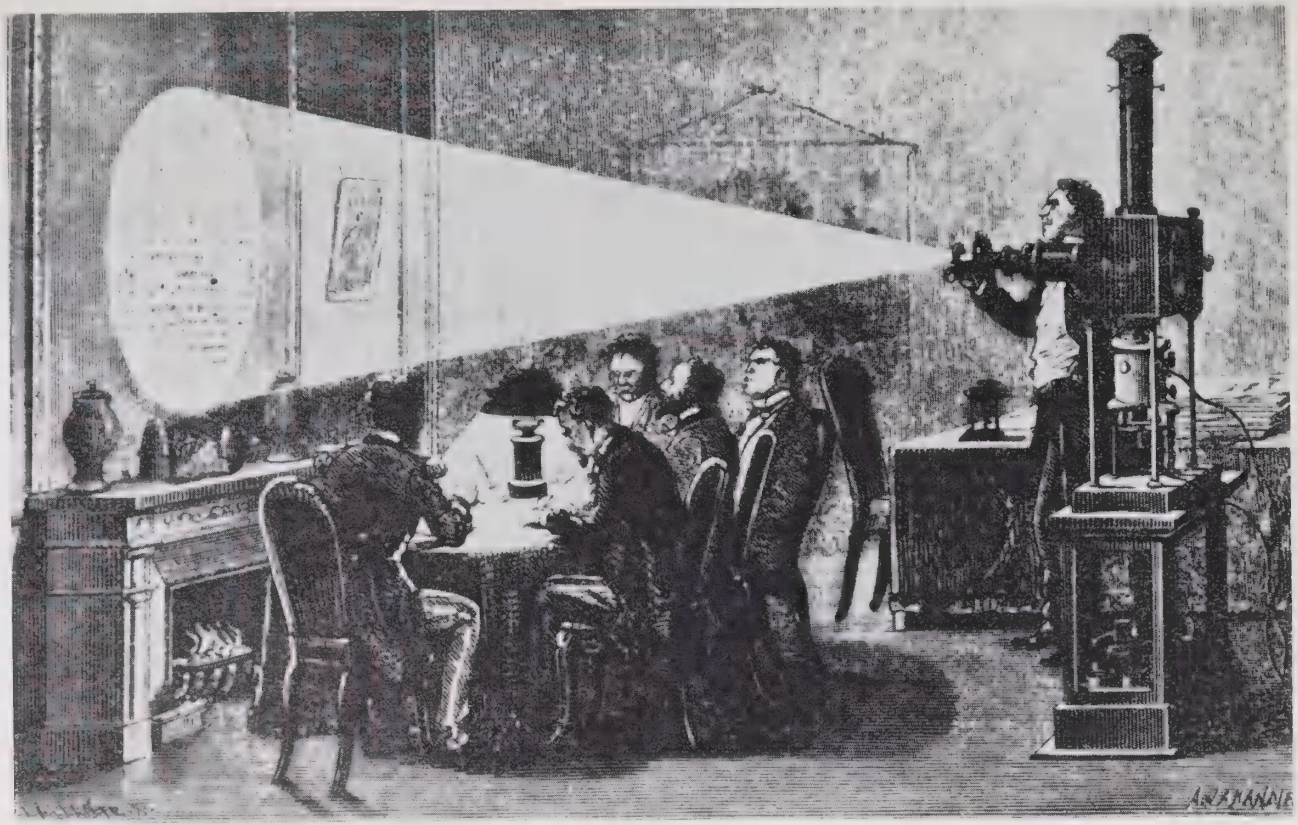


FIG. 10. — Projection of the Dagron dispatch films by means of the arc-lamp projector designed by Dubosc-Soleil. Clerks at table are transcribing the messages for delivery.

(*Both illustrations from Tissandier, G: "Merveilles de photographie"* 1874.)

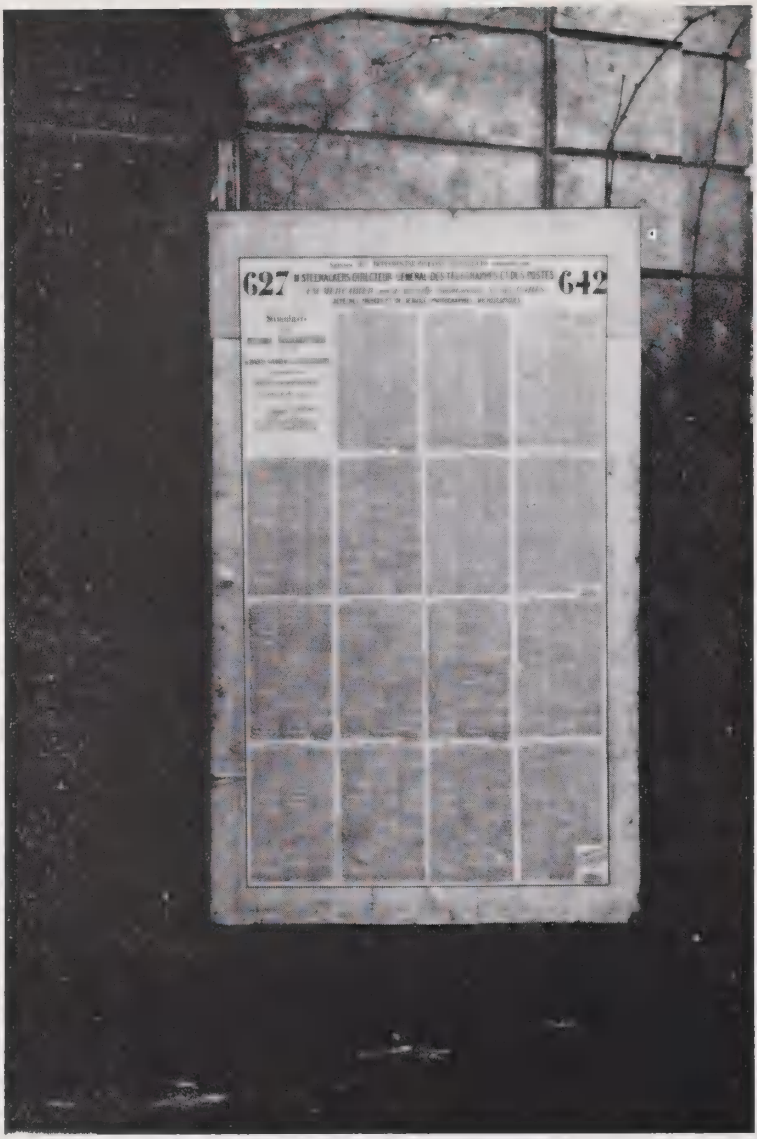


FIG. 11. — Contact print from an original Dagron plate. Because the film has not been stripped from the glass, the panel of printed dispatches can be seen attached to the side of a building.

(Collection of the author)

FIG. 12. — Enlarged detail of one of the Dagron microfilms of the Pigeon Post.

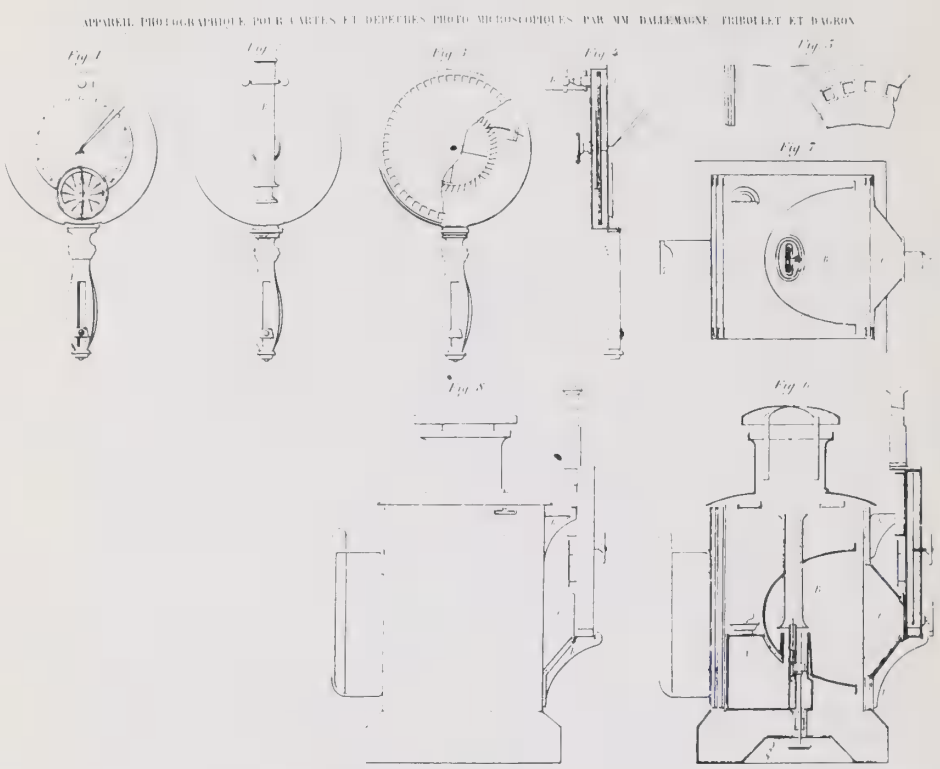


FIG. 13 — Dagron patent of 1873, showing his application of microfilm to military purposes. Films were mounted in the small windows on the periphery of the disc shown in Figs. 3 and 5. Hand viewing was accomplished with the telescope-microscope shown in B, Fig. 2. Projection on a screen resulted when the disc was mounted in front of a magic lantern.

(Brevet d'invention No. 100,735)

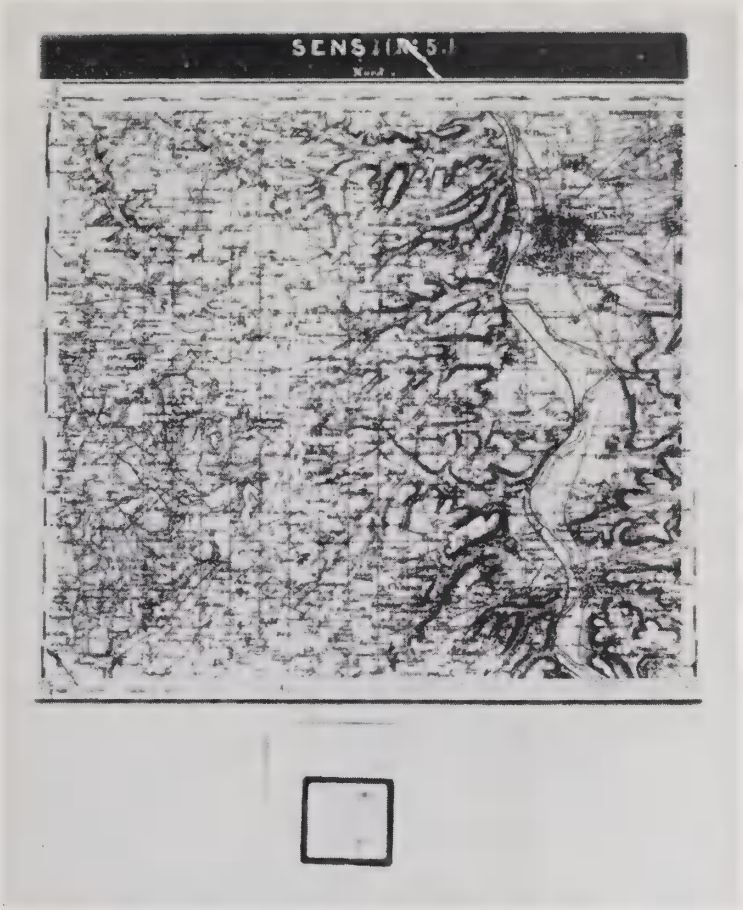


FIG. 14. — Military map of the area around Sens, France. Made by Dagron for use in his Staff-Officers viewer. The small image at the bottom is the actual size of the original.

(Courtesy, M. René Dagron II and M. Louis Saint-Rat.)

LA POSTE

PAR

PIGEONS VOYAGEURS

SOUVENIR DU SIÉGE DE PARIS

SPÉCIMEN IDENTIQUE D'UNE DES PELLICULES DE DÉPÊCHES
PORTÉES A PARIS PAR PIGEONS VOYAGEURS

Prudent René Peinture **PHOTOGRAPHIÉES**
Par DAGRON

Seul photographe du Gouvernement pour toutes les dépêches officielles et privées sur pellicule

---

NOTICE SUR LE VOYAGE DU BALLON LE NIEPCE

EMPORTANT **M. DAGRON** ET SES COLLABORATEURS

et

Détails sur la mission qu'ils avaient à remplir

TOURS — BORDEAUX

1870-1871

FIG. 15. — Title page of Dagron's book on the Pigeon Post. (1871)

TRAITÉ

DE

PHOTOGRAPHIE

MICROSCOPIQUE

PAR

DAGRON

PREMIÈRE PARTIE

APPAREILS ET ACCESSOIRES AVEC DESSINS ET LÉGENDES

SECONDE PARTIE

PRATIQUE ET MANIÈRE D'OPERER

PARIS

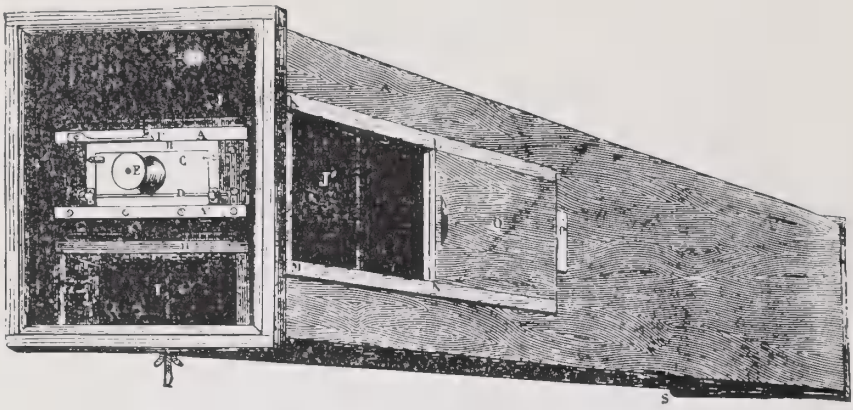
DAGRON ET Cie, RUE NEUVE-DES-PETITS-CHAMPS, 66

E. GIRAUD, LIBRAIRE
20, RUE SAINT-SULPICE

LEIBER, LIBRAIRE
RUE DE SEINE, 19

1864

FIG. 16. — Title page of the first book on microfilm techniques. Describes the Dagron process in detail.



LEGENDE EXPLICATIVE.

B. Châssis dans lequel se placent le micromètre servant à mettre le foyer et ensuite la lame de verre préparée pour recevoir les épreuves microscopiques.

C. Plaque de cuivre mobile sur l'axe D, et qui étant mise en place retient la lame de verre.

E. Microscope régulateur servant à mettre le micromètre au foyer.

Dans l'intérieur, et occupant une position contraire à ce microscope, se trouve l'objectif qui se meut entre deux coulisses. Cet objectif et le microscope E avancent et reculent en tournant sur leur pas de vis.

F. Ressort dont la pression engage la pointe de la vis G dans les huit crans pratiqués sur l'épaisseur de la partie supérieure du châssis B.

H. Banc en bois supportant l'ensemble des pièces ci-dessus.

I. Vis fixant le tube sur le banc.

J J'. Diaphragme concentrant toute la lumière sur l'objectif.

K L N M. Ouverture latérale pratiquée sur le tube, afin de pouvoir introduire la main dans l'intérieur pour régler l'objectif.

O. Glissière se mouvant dans des coulisses et fermant l'ouverture ci-dessus quand l'image est au foyer.

P. Arrêt de la glissière.

Q R S. Extrémité opposée du tube sur laquelle on place le cliché et le verre dépoli.

FIG. 17. — DAGRON'S MICROFILM CAMERA.
Placed on sale in 1864.
(*Parts described in text*).

FIG. 18.—A DANCER MICROFILM, c. 1862.

This cut was made from a 150-diameter enlargement of an original microfilm by Dancer. The enlargement measures 6x10 inches in size, so the original microfilm image is 1x1.7 mm.

(Courtesy of the Photographic Museum, Kodak, Ltd., Harrow, England).

FIG. 19.—Map showing the landing places of all balloons leaving Paris during the Siege.

L'Illustration, No. 1480, *July* 8, 1871, *p.* 26.

classic study, "The Formation of Vegetable Mould Through the Action of Earth Worms," and was so acknowledged by the great biologist in a message to Dancer dated October 25, 1881

The International Exposition in Paris in 1878 found Dagron, as might be expected, an exhibitor. Here, after having received so many "Honorable Mentions" at previous expositions, he was awarded a silver medal. During August of the same year he took advantage of the offer by Henry Giffard to use the inventor's monster captive balloon installed at the fairgrounds in an attempt to make a successful aerial photograph. That he did succeed is indicated by the presence of a print from his negative in the collections of the Conservatoire des Arts et Métiers.

Aerial photography long had been a goal in many countries. Nadar had made several attempts between 1858 and 1860, including an effort to produce militarily useful plates at Solferino during the Austro-Italian War. Across the Atlantic William Black had taken a successful view of the city of Boston in 1860, and had presented a print of the scene at the Court of St. James; this print now is in the American Museum of Photography. Two years after his Boston photography Black had succeeded in taking the first wartime aerial photographs, working from a captive balloon in the front ranks of the Union Army before Richmond. In 1863 an Italian named Negretti was unsuccessfully experimenting for King Victor Emmanuel II, and in 1868 Nadar was making trips aloft in equally unsuccessful attempts.

In order to overcome the one great handicap to aerial photography (i.e., the low sensitivity of available photographic materials, requiring long exposure with consequent blurring of the picture through the movement of the balloon), Dagron abandoned his old standby, the Taupenot dry plate for the more sensitive wet collodion plate. In the huge basket of the

balloon (which had a capacity of thirty people) he set up a dark tent for sensitizing and developing his plates. A similar tent had been used by Nadar some years earlier. The balloon itself, larger than any other balloon at that time, was handled by the Tissandier brothers, successful aeronauts of long standing. Gaston Tissandier, one of the brothers, was also a facile writer, and we have his description of the Dagron trials:

"Unfortunately, M. Dagron was unable to complete a sufficiently large number of experiments for complete success; several times the movement of the balloon precluded good results.

"However, in the month of August, during a period of calm weather and under a faultless sky, he was able to make a negative showing a view of Paris that was good enough to produce a print not entirely lacking in sharpness.

"M. Dagron installed in the nacelle of the captive balloon a very large camera, with plates 28 x 22 cm. (8½ x 11") in size. He worked with collodion.

"The photographic print obtained, a copy of which we possess, shows the Pont Neuf in the foreground, the Saint-Michel bridge on the left and the Odéon on the right; in the middle distance we see the Panthéon and all the houses of the Latin Quarter. The background is indistinct, but still permits identifying a large part of Paris.

"The photograph obtained by M. Dagron is interesting for its large size and for the view it represents."

Having completed his experiment in aerial photography Dagron devoted himself to the more prosaic aspects of his regular business, and for nine years appeared in the public prints only through the advertisements he so constantly ran. One of these advertisements, appearing in 1879, shows that in addition to his microfilm specialties Dagron was devoting more attention to other branches of commercial photography. For example, after listing his "penholders, needle cases, desk specialties, and fancy articles in bone, wood, ivory, shell, silver, etc.", he mentions his "portraits (life size) on cloth, hand colored in oils or in black and white".

For the ladies he recommends his *cartes de visite* (calling cards bearing the caller's photograph; these were popular not only in France but in England and the United States during the Nineteenth Century), his miniatures, and his portraits on shell. For the gentlemen he pronounces himself equipped for the commercial copying of letters, designs, and objects d'art. For the collectors of souvenirs and the curious he placed on sale "authentic pigeon post dispatches from the siege of Paris". The same advertisement shows that the Dagron studios have moved from the rue Neuve des Petits Champs to the corner of boulevard Bonne-Nouvelle and rue Hauteville, several blocks to the east.

In 1887, Dagron published an article on the use of collodio-albumen dry plates (the Taupenot process) in microphotography. Although Maddox had introduced the gelatin-bromide emulsion some years previous it was not ideally suited to the purposes of microfilm. The Dagron article was, therefore, still timely, and was published in America in the *Philadelphia Photographer,* and again in London in *The Camera.*

During that same year (1887) the scientific and photographic world was set a-twitter over a press release announcing that the Century Publishing Company had instituted an extensive photographic program to preserve copy "against loss or injury by fire or other wise, with the greatest convenience in storage and handling". Putting its plan into operation the Century Company microfilmed over 25,000 sheets of galley proofs, complete with pencilled corrections and additions and deletions. The proofs, measuring roughly ten by twelve inches, were reduced to 1¾ x 2 inches in the microfilming process. The press agent of the company was constrained to announce that the microfilm copies occupied less than a thirtieth of the space filled by the originals. This protection copy was stored in a special building, apart from the originals.

The cost of this program to the publishing company turned out to be approximately $320. Impressed by the inexpensiveness of the process, the company enthusiastically proclaimed that it was for the first time thoroughly protected against loss, and for an insignificant sum. Looking back they shuddered at the risks they had experienced, when no insurance policy, large though the coverage might be, could be more than a token settlement in case of disaster.

The tone of this statement, read through the eyes of a French nationalistic sentiment, seemed to imply that the Century Company laid claim to being the first to apply the techniques of microfilm to the normal channels of commerce. The *Société française,* while acknowledging the importance of the company's venture into a new field, took pains to remind the world that René Dagron had microfilmed the records of a French insurance company over fifteen years before.

The year 1889 came, and with it another World's Fair in Paris. Dagron, as usual, exhibited, and again was awarded a silver medal. It is of passing interest to note that one of the other exhibitors was a Mme. Dagron, a widow; this lady photographer, who received a bronze award, is as yet unidentified. She was probably the wife of René Dagron, who was active in the management of his company.

On March 7, 1893, the Dagron clan was augmented by the birth of a son to Dr. Georges Dagron; this boy, René (named, of course, after his grandfather) became in due time a well-known chemist and business man. He is the subject of a biography is Nath Imbert's *Dictionaire nationale des contemporains,* published in 1939.

The last listing of the elder René Dagron as an active photographer appears in 1898, when he was in his eightieth year. At this time his studio still was at 34 boulevard Bonne-Nouvelle, on the corner of rue Hauteville. Two years later,

after a lingering and confining illness, death finally came to René Dagron during an attack of paralysis. Paris had been unbearably hot for several days, the temperature reaching ninety-five degrees on the twelfth of June; the discomfort to the old man was acute, and he visibly sank under its impact. On the following day, June 13, 1900, his heart gave out, and, while a chill, persistent rain beat against the south windows, he drew his last breath.

In accordance with his last request the funeral was private, with only the family attending. It is only by a most exhaustive search that one today can find a dozen obituaries printed at the time of his death; most of these (including that in the *Times* of London) persisted in carrying forward certain misleading facts about his life.

But the life work of René Dagron had not been spent in vain. His single-minded devotion to the popularization of microfilm already had borne fruit in commercial exploitation. In the years to come this modern method for the multiplication of records was to find new fields of application far beyond the wildest dreams of the visionary Frenchman.

Chapter 9

THE CLOSE OF THE CENTURY: 1870-1900

"(We offer) one of the wonders of the age we live in, being a photograph of an entire page of the London Times, and measuring only 1⅜ x 1⅝ inches. The words, THE TIMES are visible to the naked eye. The contents are made up of a variety of communications to friends in Paris. Price, 35 cents."

Anthony's Photographic Bulletin, April, 1871

"It is well within the bounds of possibility that the scientific student of the future will do his book work with the aid of a small projection lantern and a library of small positives.

Electrical World, 1896

Commercial and governmental applications of microfilm began to suggest themselves to a number of other people in the last years of the century. As early as 1873 a microfilm holding six million words in a square inch was to be seen in the U. S. Army Medical Museum. This was the same year the French army cooperated with Dagron in developing the micro-map system of the military staff-officer.

By 1874, Vogel was complaining of indecent microfilms offered for sale. Yet, at the same time, Thomas Arthur Dillon of Dublin received a British patent for microfilming of public

records. Under the Dillon system, all deeds would be recorded photographically, and "a microscopic copy of such memorial may also be then taken for the purpose of subsequent enlargement whenever a facsimile of the original document may be required." Dillon secured a second patent on his process in 1879. Under the later patent, he described the pinning of the original records to a continuous fabric belt, and the placing of a series of dry plates in a repeating back behind the lens. A clockwork motor was set in operation, and the document and plates advanced together, stopped, the exposure was made, and the next document and plate advanced until a cycle of twenty documents had been recorded.

In 1800, two inventors from San Francisco, Eusebius J. Molera and John C. Cebrian, disclosed the methods by which their camera and reader worked. The camera worked on much the same principle as Dillon's, but the documents were arranged in several columns on the belt, so that the processed film bore a grid pattern of frames, much as in the case of the microsheet or *microfiche* film common in Europe today. The reader was much like a modern jacket or sheet microfilm reader with mechanical stage and translucent screen. Molera and Cebrian foresaw the possibility of re-designing or adapting the reader for use with microprint. Looking forward to the day of universal acceptance of microfilm, the Californians claimed that their equipment and process provided the means of "collecting, keeping, using, and transmitting in a condensed and imperishable manner all kinds of copies or records. . . (which) may be rendered universally accessible by reason of their cheapness, their small size and light weight, their imperishable character, and the facility with which they may be multiplied".

In 1890, a resident of Sleepy Eye Lake, Minnesota, applied for a patent on a multiplying-back dry plate camera which

was used for producing frames the size of a postage stamp. The inventor, Soren C. Madsen, claimed its use primarily for the copying of photographs.

In 1896, Reginald A. Fessenden, an early American radio engineer, designed a camera for his own use in collating the many references from scientific journals. His reduction ratio was in the order of 10 diameters and the microfilms (still attached to glass plates) were filed in envelopes glued to the back of his 3x5" reference cards bearing title, contents, and annotations. Reading was done with a small magnifying glass.

During the closing years of the century, four Chicagoans were working on automatic cameras for the recording of checks: their work was completed between 1899 and 1901, and filed in two separate applications with the U. S. Patent Office. These men (Thomas Jansen, William H. Gardiner, Edmund Kandler, and Achilles de Khotinsky), used cellulose film passing over a friction roller pulldown activated by a solenoid. Khotinsky added the novel feature of having a second soleniod rotate the copyholder to present first the face of the check, then the endorsment, to the lens.

Many other individuals were undoubtedly using the process for commercial and research projects. The introduction in June 1888 of the Number 1 Kodak, with its internationally famous slogan, "You push the button — we do the rest", brought photography into the hands of the amateurs. As soon as the first successful celluloid films coated with gelatin-bromide emulsions were placed on sale in 1889, the advanced amateurs finally had an easily handled material which could be processed in their own darkrooms. The standardization in 1889 by Thomas Edison on film 35 mm. (one and three-eighths inches) wide in long ribbon form for motion picture use set the pattern for the development of compact, high quality cameras for microfilming.

To paraphrase the remarks of Shadbolt in the 1850's, it was only natural that a man tired of laborious copying of data — with all the possibilities of error in that copying — would turn to his camera to do the job rapidly, inexpensively, and accurately. From the experiments of an individual would arise commercial application. In 1900, for example, George Biedler, a clerk in an Oklahoma City abstract office, invented the photocopy machine for use in his own office; in 1904 he formed the Rectigraph Company (now The Haloid Company) to market his camera, which became the first "stat-type" machine.

All of the developments in microfilm trace their ancestry directly back to the efforts of two men: John Benjamin Dancer, who pioneered the field in experimentation and tentative moves toward commercialization; and René Prudent Patrice Dagron, who placed the medium on a firm commercial basis.

Dancer was born as news arrived that the armies of Napoleon Bonaparte had captured Moscow; Dagron died the very day the city fathers of Newport, Rhode Island, voted to curb the speed-mad Vanderbilts and Belmonts by setting a speed limit of 6 miles per hour on that new plaything of the rich, the automobile. Both men lived through the golden age of photography. Theirs was the thrill of hearing the birth of the infant science, of seeing it develop into one of the most influential of all media of communication.

In the 88-year span of their overlapping lifetimes they saw novel applications by the score open up for the new technology; they, who laid the foundations for one of the most widespread of these applications, microfilm, saw photography extended into the highly specialized branches of mankind's varied sciences and arts. They saw the Photographic Society of London founded in 1853, the *Société française de photographie* in 1854. They saw the beginnings of military pho-

tography in the Crimean photographs of the Englishman Fenton in 1855, and in the Union Army's pictures by the American Brady in the Sixties. They were active photographers when Black photographed Boston from a balloon in 1860 and when Buchanan signed the first U. S. photographic copyright law in 1861. Dancer was 52 and Dagron 45 when Alfred Stieglitz was born in Hoboken; and it was just five years later that Ducos du Hauron published his classic "*Les couleurs en photographie*" in 1869.

In 1871 William Henry Jackson was photographing the unbelievable Yellowstone for a skeptical Congress; in 1876 Jules Janssen designed and built the first motion picture camera; and in 1880 photography was first successfully applied to newspaper reproduction through the invention of the halftone screen.

Between the deaths of Dancer and Dagron, Edward Anthony, America's first government photographer, passed from the scene; Bertillon published his famous theory on photographic identification and classification, long and widely used in criminology; and Röntgen discovered the X-rays through photography.

This, then, was the world of Dancer and Dagron.

DOCUMENTS AND NOTES

IN WRITING a history such as this, the author must decide where to place supporting and supplementary material important to a full understanding of the personalities, means of achievement, and technical background of the men who made important contributions to the development of the industry. Several courses are open: the use of extensive parenthetical digressions within the body of the text; the incorporation of such data in footnotes at the bottom of each page; the gathering of such footnotes at the end of each chapter; the incorporation of all material in appendices or chapter groupings at the end of the book.

I have chosen the latter course for several obvious reasons. First, the incorporation of extensive descriptions of technical processes in the story would have seriously broken into the flow of narrative. Second, the use of footnotes would have converted what should be a book of introduction to the heritage of modern microfilming practice into a textbook, and also interrupted the smooth continuity of reading. Third, the use of full chapters would permit the full use of available space to reproduce supplementary matter in its complete form, to be read in full or scanned quickly at the reader's choice; any later reference to the documents would also be far easier and involve less searching time.

Therefore, the following chapters were written with this purpose in mind. A tabular chronology of events is presented in Chapter 10. A note on the original sources from which the chronology and the text were drawn appears as Chapter 11. Because the art of ballooning no longer forms a part of the experience of visitors to the county fairs as it did a generation

or two ago, a rather detailed account of how balloons were made and used before man invented the airplane is given in Chapter 15; this account also presents the first details in English of the thrilling and dangerous experiences of those 159 intrepid men who travelled over enemy lines on the capricious winter winds some 88 years ago. Chapter 16 gives a clearer understanding of the role the pigeons played in carrying the V-mail messages of 1870-71; such information undoubtedly will be considered elementary and old-hat by those who engage in modern pigeon racing, but I doubt that many of the readers of this history engage in such sport. Finally, I believe that the contents of Chapter 17 will be of considerable interest insofar as their backgrounds outside the direct connection with microfilm will help show why several of the minor characters of our story exerted the influences they did on a specific phase of that story.

The translations in full of the two pamphlets published in Chapters 13 and 14 are the first to tell in modern English the story of the world's first commercial microfilm practices and his experiences during the Siege of Paris in Dagron's own story. My goal has not been a scholarly or literary translation, but rather one which preserves the flavor and modern meaning of Dagron's exposition and expression. As the eminent English translator of Chinese poetry, Arthur Waley, put it so aptly in an article in the *Atlantic Monthly* for November 1958, "What matters is that a translator should be excited by the work he translates, should be haunted day and night by the feeling he *must* put it into his own language . . . You may question at this point whether it is right to call him (Lin Shu) a translator at all. But . . it would be misleading, I think, to use such terms as 'paraphrase' or 'adaptation'. In any case, he was the transmitter, . . . of European fiction to China".

This, then, has been my own purpose: to make available

to those interested the story of these exciting events, where practicable in the flavor of the pioneers themselves or their contemporaries, bolstered by supplemental notes of my own to help the reader enter into the very atmosphere of the Nineteenh Century.

Chapter 10

CHRONOLOGY OF MICROFILM DEVELOPMENTS

1800 - 1900

1802: June 22: Wedgwood and Davy publish the results of their experiments, which succeeded in producing (impermanent) photographs.

1812: October 8: John Benjamin Dancer born in London.

1819: January 8: Herschel announces photographic fixing agent (sodium thiosulphate, or "hypo".)

March 17: René Prudent Patrice Dagron born in Beauvoir, Sarthe, France.

1826-1827: Niepce produces the world's first camera photograph from nature.

1829: December 14: Niepce and Daguerre sign contract of partnership.

1833: July 5: Niepce dies.

1835: February: Fox-Talbot makes first permanent paper contact prints from negatives.

1839: January 7: Arago announces to French Academy of Sciences that Daguerre has perfected a practicable method of photography.

March 14: Herschel announces that hypo will fix out silver images and coins the word "Photography".

August 4: Breyer shows the first reflex-copied photographs.

August 19: Arago gives details of the Daguerre process (now named the daguerreotype) before an excited Academy of Sciences, after the French Government has granted

Daguerre and the son of Niepce lifetime pensions for making the process available to all persons without royalty.

August 31: Publication of the first edition of the *Manual* of the daguerreotype process.

Autumn: Dancer makes first microphotograph on a daguerreotype plate at 160x reduction.

1842: April 19: Dancer elected a member of Manchester Literary and Philosophical Society.

1844: ——: World's first photographic salon opens in Paris.

1846: ——: Whipple of Boston makes microphotographs on daguerreotype.

1851: March: Scott-Archer publishes "On the Use of Collodion in Photography" in *The Chemist.*

July 12: Daguerre dies in Paris.

1852: February: Dancer makes collodion microfilms.

1853: March 3: Rosling shows microfilm of a newspaper before the Photographic Society of London.

April 21: Dancer publishes his "On a Portable Camera . . . for the Collodion Process" in *Journal of the Photographic Society,* Vol. I, No. 3.

May: Dancer makes microfilms of Sturgeon inscription.

May 21 et seq. *Notes and Queries* publishes numerous suggestions for library microfilming.

July 9: *Athenaeum* publishes letter on Herchel's "old idea" for microfilming reference materials.

Autumn: Sidebotham produces microfilms by Dancer's instructions.

1854: January 28: *Notes and Queries* describes Diamond's microfilm of Fifteenth Century manuscript.

Early March: Shadbolt makes microfilms ⅝ mm. in size.

March 29: Shadbolt puts first consignment of 24 microfilms out for sale.

July 12: George Eastman born in Waterville, N.Y.

1855: ——: Jackson makes microfilms according to Shadbolt's instructions.

August 24: Scott-Archer patents the method of stripping collodion pellicles from glass plate support after the image is processed.

September: Taupenot publishes details of the collodio-albumen process, the first practical dry collodion plate. This is the process Dagron used.

1856: Spring: Dancer shows his novelty microfilms to Sir David Brewster.

September 5: Dancer receives British Patent No. 2064 on twin lens stereo camera.

April 20: Dancer receives French Patent No. 18,400 for a quick-change plate magazine for his stereo camera.

1856-57: Winter: Brewster shows Dancer's microfilms in Italy and France. Suggests their use in jewelry and trinkets, and for espionage purposes.

1857: September: Microfilms by Dancer and Bertsch exhibited before the British Association for the Advancement of Science.

October: Brewster described at length Dancer's microfilms in the 8th Edition, *Encyclopaedia Britannica.*

November 5: Shadbolt publishes his claim to invention of microfilming, based on his 1854 work.

1858: ——: First edition of Sutton's "Dictionary of Photography" deprecates microfilming "as somewhat trifling and childish". (Second edition, in 1867, carries a lengthy description of how to do it, however).

1859: April 6: Sidebotham starts Dancer-Shadbolt controversy over priority of microfilm experiments.

May 15: Shadbolt publicly acknowledges Dancer's priority.

May 25: Microfilm exhibited in Terre Haute, Indiana.

June 21: Dagron receives world's first microfilm patent (French Patent No. 23,115) for "a novelty microscope giving an illusion of depth".

——: Microfilms exhibited at the Paris Photographic Salon were "the marvels of the Exposition".

1860: ——: London experimenters were using mica as a film base.

March 8: Dagron receives additional coverage for his French Patent No. 23,115).

March 28: Dagron receives British Patent No. 801 (same as French Patent No. 23,115).

June 26: Dagron receives second addition to his French Patent No. 23,115.

1861: ——: Disderi establishes first Photographic Section in the French Army.

March 3: President Buchanan signs the first U. S. photographic copyright law.

——: There are 10,000 photographers in the British Isles.

April 4: Martinache receives French Patent No. 49,123 on hand viewers.

May 7: Martinache receives Addition to French Patent No. 49,123.

Summer: Dagron sues Martinache for infringement on his patent.

May 8: Héricé receives French Patent No. 49,624 on hand viewers.

June 8: Héricé receives addition to French Patent No. 49,524.

July 18: Berthier (Dagron's employee) receives French Patent No. 50,469 on hand viewers.

July 23: Dagron buys Martinache's French Patent No. 49,123.

July 29: Cuvillier receives French Patent No. 50,625 on hand viewer.

August 13: Dagron receives U. S. Patent No. 33,031 (Same as French Patent No. 23,115).

Summer: Dagron files suit for infringement against 15 opticians of Paris.

September 2: Cuvillier receives French Patent No. 51,017 on hand viewer.

September 19: Dagron receives British Patent No. 2347 on improved hand viewers.

October 18: Dagron's business described in detail in *Bulletin, Société française de photographie.*

1862: January 28: Dagron loses lawsuit to Paris opticians.

February 20: Héricé receives Second Addition to French Patent No. 49,264.

Summer: Dagron exhibits microfilms at the London World's Fair; receives Honorable Mention; presents a set to Queen Victoria.

——: Dagron publishes his "Cylindres photo-microscopiques

montès et non-montés sur bijoux, brevetès en France et à l'étranger". Paris, octavo, 36.

1863: October 12: Col. Pike publishes his experiments with the Dagron process in America.

1864: January: Brewster addresses the Photographic Society of Scotland on the Dagron process.

——: Dagron publishes his "Traité de Photographie Microscopique". Paris, 18-Mo., 36p. illustrated. Gives details of his process and price list of his equipment and supplies. This is the world's first book on microfilming techniques.

— John H. Morrow opens first American commercial microfilm laboratory.

January: Emperor Napoleon III authorizes Dagron to advertise himself as Supplier of Photographs to the Emperor.

——: German publication, *Photographisches Archiv,* complains of obscene microfilms flooding the market.

1865: ——: Simpson proposes publication of books on microfilm.

1866: ——: Dallas publishes a microprint (?) bible in England.

1867: ——: Sutton's "Dictionary of Photography" (Second edition) carries a lengthy description of microfilm processes.

March 13: Anguier and Langlois receive French Patent No. 77,132 for animated microfilms.

Summer: Dagron wins Honorable Mention at Paris World's Fair.

1868: June 5: Anguier announces his animated microfilms.

1869: June 15: John W. Hyatt receives U. S. Patent No. 88,634 for production of nitrocellulose (celluloid), not necessarily in the form of film.

1870: July 19: Emperor Napoleon III declares war on Prussia.

September 1: Napoleon surrenders at Sedan with 100,000 men of the French Army.

September 4: Léon Gambetta proclaims the end of the Empire and birth of the Third French Republic.

September 7: New government decides to defend Paris against the Prussians.

September 12: Steenackers arrives in Tours by land with first group of pigeons. Sets up communication systems.

September 18: Gates in city wall of Paris closed.

September 19: Prussians surround Paris and cut last communication with Unoccupied France.

September 23: First mail balloon leaves Paris.

September 25: First pigeons return to Paris (carried out by second balloon).

October 7: Léon Gambetta, Minister of War and Interior, leaves Paris on the fifth balloon. Arrived in Tours to establish the provincial Delegation of National Defense.

November 10: Central government in Paris signs contract with Dagron and Fernique.

November 12: Dagron and Fernique leave Paris by Balloon No. 27, the *Niepce.*

November 21: Dagron arrives in Tours.

November 29: Delegation finally authorizes Dagron to replace the microprint service of Blaise with his own microfilm service.

December 5: Dagron makes first official microfilm dispatches.

December 11-12: Delegation, with Dagron and Fernique (but not their staff) hurriedly move from Tours to Bordeaux.

December 24: Goose for Christmas dinner was selling for $25.00 in Paris, chicken for $7.00.

December 31: Dagron and Fernique sign renegotiated contract with the Delegation.

1871: January 28: Paris and Free France capitulate: Dagron has delivered 115,000 messages to Paris by pigeon.

March 1: First of 30,000 Prussian occupation troops enter Paris.

March 2: Treaty between Prussians and French signed at Bordeaux.

March 3: Prussians leave Paris in accord with terms of the treaty. Communards again try to take over.

March 18: French Army troops refuse to fire on rebels, and government flees to Versailles.

March 26: Election of Communal Assembly of 106 members.

April: Dagron proposes microfilming records in the Finance Ministry.

April: Pigeon post microfilms offered for sale in U.S.A.

May 21-29: Government re-enters Paris. Fighting in streets. Finance Ministry burned, with loss of "every record and scrap of paper".

May 29: Communards surrender to the Government.

Spring: Dagron microfilms records of an insurance company.

Spring: Fleury-Hermagis proposes microfilming all manuscripts in the Bibliothèque Nationale.

Summer: Dagron reproduces 130,400 letters on a microfilm frame 0.5 mm. square.

Summer: Dagron publishes his "La Poste par pigeons voyageurs".

December 12: A paper, "On the Preparation of Micro-Photographic Despatches on Film by M. Dagron's Process" read before the Royal Photographic Society in London.

——: Maddox introduces the gelatin-bromide dry plate.

1872: ——: Publication of Scamoni's "Handbuch der Heliographie" (microprint).

1873: July 16: Dallemagne, Triboulet and Dagron file for U. S. Patent No. 146,052 on hand viewers.

July 26: Dallemagne, Triboulet and Dagron receive French Patent No. 100,735 on military microfilm map reader.

December 30: Dallemagne, Triboulet and Dagron receive U. S. Patent No. 146,052 on hand viewers.

——: Vogel discovers dye sensitization of film, leading to orthochromatic and panchromatic emulsions.

1874: June 4: Dillon receives British Patent No. 1935 on a microfilming process for the recording of deeds.

——: Liverpool Dry Plate Company introduces the first successful dry plates.

1875: February 11: Dallemagne, Triboulet and Dagron receive French Patent No. 106,767 on an improved version of their 1873 map reader.

July 27: Dallemagne, Triboulet and Dagron receive an Addition to their French Patent No. 106,767.

1876: Summer: Many microfilms in trinkets shown at Centennial Exposition in Philadelphia.

1878: Summer: Dagron receives Silver Medal at Paris World's Fair.

1879: March 18: Dillon receives British Patent No. 1073 on method for microfilming deeds.

1880: January 27: Molera and Cebrian file for U. S. Patents No. 230,322 and 230,324 on camera and reader.

July 20: Molera and Cebrian receive U. S. Patents No. 230,322 and 230,334.

March 20: Molera and Cebrian receive British Patents Nos. 1216 and 1217 on camera and reader.

——: New York *Daily Graphic* publishes first photographic halftones.

November: George Eastman establishes The Eastman Dry Plate Company.

1884: ——: George Eastman applies for and receives U. S. Patent No. 306,594 on coating rolls of paper with a stripping film emulsion.

——: Dancer dictates part of his autobiography to a granddaughter.

1885: March 26: Eastman Dry Plate and Film Company begins production of roll paper carrying a stripping film emulsion.

——: *Anthony's Photographic Bulletin* carries first description of the photographic properties of diazo compounds.

1886: —— Abbé and Schott produce first modern optical glass.

1887: March 4: *Bulletin, Société française de photographie* announces the plan of Cosmos Publishers to microfilm all manuscripts in their custody for fire protection.

March: *Journal of the Franklin Society* in Philadelphia announces that The Century Company, publishers of encyclopaedias, has microfilmed over 25,000 page proofs on frames 1¾ x 2" in size for protection against loss and "the greatest convenience in storage and handling".

May 2: Rev. Hannibal Goodwin applies for patent on nitrocellulose film as a base for photographic emulsions, subject of extended litigation between the Eastman and Ansco companies.

Summer: Dagron publishes a lengthy description of his method of processing microfilm in The *Philadelphia Photographer* and *The Camera.*

November 24: John Benjamin Dancer dies in Manchester at age of 75.

1888: June: Eastman announces the Number 1 Kodak, using factory-loaded and processed paper stripping film, and establishes

the history-making slogan "You press the button — we do the rest".

September 4: Eastman registers the coined word "Kodak" as a trademark.

1889: ——: Dagron receives Silver Medal at Paris World's Fair.

August 19: The daguerreotype process is fifty years old.

Summer: Eastman begins manufacture of nitrocellulose film.

September 2: Thomas Edison establishes 35 mm. as the first standard film gauge for nitrocellulose-film, and buys his first motion picture film from the Eastman Company.

December 10: Harry Reichenbach of the Eastman Company receives U. S. Patent No. 417,202 on nitrocellulose film base coated with an emulsion.

1890: ——: Arthur Green patents the first direct positive diazo process. Madsen applies for U. S. Patent No. 448,447 on a microfilm camera.

1891. ——: Eastman announces daylight-loading roll film for amateur cameras.

March 17: Madsen receives U. S. Patent No. 448,447 on a microfilm camera.

1896: August 22: Fessenden describes his microfilming of research materials in *Electrical World.*

1898: September 13: Rev. Hannibal Goodwin receives (posthumously) U. S. Patent No. 610,861 on nitrocellulose film base.

1899: June 12: Thomas Jansen, William H. Gardiner, and Edmund Kandler apply for U. S. Patent No. 655,977 on a check microfilming camera.

1900: ——: George C. Biedler invents Rectigraph Photocopy Machine.

August 14: Jansen, Gardiner and Kandler receive U. S. Patent No. 655,977 on a check microfilming camera.

June 13. René Prudent Patrice Dagron dies in Paris at age of 81.

Chapter 11

BIBLIOGRAPHIC NOTE

Exhaustive research in several dozen libraries (but primarily in the New York Public Library and the Library of Congress), plus extensive correspondence with persons (including Dagron's grandson) both here and abroad during the years 1934-1959, during which the author garnered some 400 references to the work of Nineteenth Century microfilm personalities by scanning an estimated 30,000 volumes, produced the facts set forth in this book. For example, he examined each issue still existing of the many photographic and scientific journals published in France, England, Germany and the United States between 1850 and 1900. In consulting over 90 different encyclopaedias and biographical dictionaries published over the years, from Norway to Portugal, from Greece to Philadelphia, he found but a few pertinent items.

Little by little, the story of the early days of microfilming techniques and application took form. Dancer was the subject of a few short British memorials of appreciation published while his son was still alive at 81; these articles provided the necessary background material on his family, his personality, his activities outside the realm of microphotography. The British journals of 1857-1859 provided the story of his work

in microphotography, due largely to the vigorous championing of his cause by his friend, Joseph Sidebotham. A thorough evaluation of the work of Dancer and others during the period 1839-1869 was published in my article "Earliest Experiments in Microphotography" in 1950, and documented there with 48 references to the journals of that period.

The story of Dagron and the pigeon postal service of 1870-71 was and is better known, although most modern references to it show major errors of fact. To my knowledge, no English translation of Dagron's own booklet on that service has ever before been made in a form easily understood by modern microfilm practitioners. Such a translation appears in Chapter 14. Material from the published works of Fernique and Steenackers, two of the other principals in the pigeon service and the associated political troubles, appears in Chapter 7. An analysis of the use of microfilm during this period was published in my article "René Dagron and the Siege of Paris" in 1950, and documented there with 52 references to the journals, newspapers, and books of the 1870's. Even the French catalogs for airmail stamp collectors were productive of new data.

Getting the full story of the work of the Dagron laboratory and other microfilm workers in the period 1859-1900 meant searching the patent files of France, England, and the United States; examining almost page by page such rich lodes as fifty years' issues of the Bulletin of the French Photographic Society; ferretting out the remains of long extinct technical journals such as *Humphrey's Journal Devoted to the Daguerreian and Photogenic Arts*, checking file after crumbling file of newspapers and news magazines dating from 50 to 120 years back. The description of Dagron's birthplace and the every day life of his boyhood community is largely taken from a statistical gazetteer of the Department of Sarthe published in 1829, when Dagron was 10 years old.

Thus, to include a complete bibliography in the letterpress edition of this book would be voluminous and devoid of any value to the casual reader. A full list of sources used to produce this book is given in the microformat editions, however, for the use of later research workers; such editions in film and paper will be found in major research libraries of the country.

The following fourteen selected references may be used for those who may wish to examine the primary source records for the stories of Dancer's experiments leading to the firm establishment of the microphotographic process, and the story of Dagron's work during the Siege of Paris:

Dancer:

1. Luther, Frederic: "The Earliest Experiments in Microphotography". ISIS: Journal of the History of Science Society, XLI, Parts 3-4, Numbers 125-126 (December, 1950), pp. 277-281.

This article was reprinted in *American Documentation,* II, 3 (August 1951) pp. 167-170. In both journals, the full bibliography of 48 entries is given.

2. Shadbolt, George: "On the Mode of Producing Extremely Minute Photographs for Miscroscopic Examination". *Liverpool and Manchester Photographic Journal,* N.S. No. 22 (15 Nov. 1857) pp. 244-246.
3. Sidebotham, Joseph: "On Micro-Photography". *The Photographic Journal,* VI, 92 (15 April 1859), p. 91.
4. (Editorial by Shadbolt, editor): "Palmam Qui Meruit Ferat". *The Photographic Journal,* VI, 93 (1 May 1859), pp. 104-105.
5. (Editorial by Shadbolt, editor): "Palmam Qui Meruit Ferat". *The Photographic Journal,* VI, 94 (15 May 1859), p. 118.

These five articles established the priority of Dancer's claim to being the first microphotographer.

6. Garnett, Henry: "John Benjamin Dancer — a Pioneer Microscopist and Inventor". *English and Amateur Mechanics,* I, 25 and 26 (April 1927) pp. 430, 446.

7. Stirling, J. F.: "A Forgotten Genius: John Benjamin Dancer, Microscopist, Optician and Instrument Maker".
Watson and Sons, Ltd. Microscope Record,
No. 44 (May, 1938), pp. 3-6
No. 45 (Oct. 1938), pp. 12-16
No. 46 (Jan. 1939), pp. 8-10
No. 47 (May, 1939) pp. 12-14

8. Garnett, Henry: "John Benjamin Dancer; Instrument Maker and Inventor". *Manchester Literary and Philosophical Memoirs and Proceedings.* LXIII (1928-1929). Memoir No. 2 , pp. 7-20.

These three articles provide an excellent summary of Dancer's life and activities.

Dagron:

1. Luther, Frederic: "René Dagron and the Siege of Paris."
American Documentation, I, 4 (October 1950), pp. 196-206.
Carries the full bibliography of 52 entries.

2. Dagron, M.: "Cylindres montés et non montés sur bijoux brevetés en France at à l'étranger". Paris, 1862, 36 p.

3. Dagron, M.: "Traité de photographie microscopique". Paris, 1864 36 p.
Item 3 gives the details of Dagron's commercial process and appears in this book as Chapter 13. No copy of Item 2 is known to exist in the United States.

4. Dagron, M: "La Poste par pigeons voyageurs". Paris, n.d. 24 p.
This booklet gives Dagron's own account of the trip by balloon and his work during the Siege of Paris. Several printings are extant, each showing minor variations in the text. A translation of one of the versions appears in this book as Chapter 14.

5. Fernique, Albert: "Un Voyage en ballon pendant le siège de Paris". Saint Quentin, 1871, 18 p.
An account, supplementing Dagron's "La Poste", by Dagron's associate in his troubles with the Delegation.

6. Steenackers, François Frédéric: "Les Télégraphes et les postes pendant la guerre de 1870-1871; fragments de memoires historiques". Paris, 1883, 600 p. The account of the pigeon postal service from the viewpoint of the Director General of Telegraphic and Postal Services for the Delegation.

Chapter 12

MICROFILM PROCESSES

1. The daguerreotype: Dancer's first process (1839-1852).
   a. A metal plate, of silver-coated copper of the size of the desired photograph, is sensitized to light by fuming with the vapors of iodine.
   b. The exposure, of a half-hour duration under strong sunlight at first, later was reduced to a matter of a few minutes.
   c. The exposed plate is then developed to a visible, direct positive image by subjecting the surface of the plate to the vapors given off by a pool of mercury.
   d. The image is fixed out by immersion in a bath of potassium cyanide or of hypo, and the image toned in a gold thiosulfate bath.
   e. The daguerreotype is a positive-image opaque image on metal, viewed by reflected light. It is a fine-grained image, but of weak brilliance.

2. The Scott-Archer Process: Wet Collodion: Dancer's later medium (1852).
   a. Collodion-nitrate (guncotton), dissolved in ether (or alcohol) and a solution of bromide and potassium iodide is flow-coated on a glass plate, and allowed to dry to "just the right degree of stickiness".
   b. The plate is next sensitized by immersing it for 3 to 5 minutes in:

Silver nitrate	24 grams
Potassium Iodide	0.1 gram
Water to make	350 c.c.

c. It next is drained, placed in the plate holder, exposed in the camera, and developed while still wet from the sensitizing bath. "The time between flowing the collodion and developing should not exceed eight or ten minutes".

d. The developer used may be one of several variants. For contrast, the following formula may be used:

Iron Sulfate	23 grams
Acetic acid, glacial	20 c.c.
Lump sugar	11.5 grams
Methyl Alcohol	27.5 c.c.
Water to make	500 c.c.

Develop in tray by inspection, with constant agitation.

Fix in:

Potassium cyanide	13.5 grams
Water to make	500 c.c.

3. The Taupenot-Dagron Process (1855-1871).

a. A modification of the Scott-Archer process. Glass plates are coated with collodion, dried, and stored before sensitization.

b. "J. M. Taupenot, however, seems to have been the first to use a dry-plate process that was really workable. His original plan was to coat a plate with collodion, sensitize it in the ordinary manner, wash it, cause a solution of albumen to flow over the surface, dry it, dip it in a bath of silver nitrate acidified with acetic acid, and wash and dry it again. The plate was then in a condition to be exposed, and was to be developed with pyrogallic acid and silver. In this method we have a double manipulation, which is long in execution, though perfectly effective".

c. It is sensitized in a silver nitrate solution, washed, and dried and can be kept for several weeks before exposure. For fineness of detail, the Taupenot process is superior to the gelatin-emulsion films in commercial microfilm use today. Exposure, however, is about six times longer than with wet collodion.

d. Dagron exposed his microfilms in the camera as conventional glass plates. Several methods were used, of which two are given here:

1. (1864: Production of microfilm novelties): A glass plate negative of conventional size was made and placed in a copy-holder of the microfilm camera. At the other end of the camera a multiplying back held a sensitive plate roughly one

by three inches in size behind a one-inch lens producing an image covering one-eighth of the tiny plate. The lens was moved to a new position on the plate for each one- to three-second exposure to sky light. The exposed plate was developed in pyrogallol, and the eight images cut apart and cemented to Stanhope magnifiers. Dagron priced this camera to the trade at 110 francs, the Stanhopes at 8 francs per gross, and a cup of Canada balsam for cementing the glass micropositives to the Stanhopes at 5 francs. For production in his own laboratory, Dagron used a similar camera, equipped with a battery of twenty lenses of very short focal length, thus producing twenty identical copies each one millimeter square at a single exposure.

2. (1870-71: The Pigeon Post): At the outset, Dagron was supplied with large printed sheets holding twelve pages of telegraphic type dispatches. Each sheet was then cut in two, and the resulting sheet of six pages contact-printed on a dry collodion plate. The negative plate was then placed in the copyholder of Dagron's 20-lens camera, the sensitive plate shifted, and a second set of 20 exposures placed beside the first set. This produced 40 identical positive images of the same page, so that copies could be sent again and again by separate pigeons to insure arrival in Paris. By soaking the plates in a castor oil solution the image-bearing collodion could be stripped from the glass, resulting in a tough, featherweight film. Individual pages cut from the film were assembled on a clear pellicle with other pages produced in the same way. The pellicle then was tightly rolled together with as many as 17 other pellicles to form a single pigeon's cargo. The assembly was placed in a quill which was sealed and attached to a selected feather in the tail of the pigeon. On arrival in Paris the rolled pellicles were soaked in alcohol or ammonia and carefully flattened for transcription or enlargement. Examination of a pellicle in the possession of the author, however, shows that it was produced by direct microfilming of a panel holding 16 pages of letterpress messages. The pellicle has never been stripped from its glass support, and shows the panel mounted on the outside wall of a stone building,

illuminated by the weak sunlight. Although Charles Fabre wrote in 1890 that the panels were about 6½ x 8½ feet in size, Lodewyck Bendikson in 1935 estimated the size to be about 3½ x 5½ feet, and the specimen at hand seems to bear out the smaller size. Even so, the resulting pellicle image, measuring 1¼ x 2" (about the size of a modern full aperture 35 mm. frame), represents a reduction ratio of 32 diameters. Each of the 16 pages carries upwards of 200 separate messages, so each pellicle carried nearly 3,000: a single pigeon load of 18 pellicles would represent over 50,000 messages of from five to twenty words each.

Chapter 13

"TRAITÉ DE PHOTOGRAPHIE MICROSCOPIQUE"

Treatise on Microscopic Photography

By DAGRON

PARIS, 1864

Foreword

The most recent and most complete treatises on photography hardly mention the name of microscopic photography. This branch has become in five years, however, a real industry, tributary to some thirty types of manufacture, notably that of the jewelry trade.

One may search in vain in all manuals of photography to find the data needed for the making and mounting of those tiny images which can be magnified to infinity.

We have not been able to secure these data without difficulty. It required laborious effort before we could obtain consistently those minuscule images, which were necessarily created perfect since retouching is impossible. But, since we have succeeded far beyond our hopes, since this work has become today the easiest and fastest of the arts associated with the admirable discovery of Niepce and Daguerre, we believe we can be of ser-

vice in revealing here our entire process, just as it is used in our laboratory. No one has produced in such quantities as we this product we invented; we can find no one with experience greater than ours. Other people will perhaps wish to place this charming invention within reach of everyone; we offer to all, at most reasonable prices, the means of easily and economically producing those little cylinders called Stanhopes, as well as those gem stones of all shapes and colors, mysterious objects wherein each may enclose that which in all the world is most precious to us.

PART I

EQUIPMENT and ACCESSORIES

We manufacture in our laboratories, under careful inspection, equipment for microscopic photography. We deliver such items only after having tested them in our studio.

The most important piece of equipment is the copying camera; here is how it looks, its parts, and how it works:

B. Manipulator stage. In the stage we place a finely ruled micrometric scale, or focusing plate, used for bringing Microscope E into sharp focus on the focal plane.

C: Brass frame, opening on Axis D, which holds the glass photographic plates.

E: Microscope viewer for determining critical focus for the lens.

Within the cabinet, occupying a position opposite the miscroscope, is the objective lens, which slides in two grooves. The lens and Microscope E are racked in and out for focus on their own screw drives.

F: Spring, whose pressure engages the point of Screw G in the eight notches found in the upper part of Stage B.

H: Wooden support for Assembly A-G.

I: Hold-down screw maintaining Assembly A-H in place within the camera.

J: Partition excluding all stray light from the objective lens.

KLMN: Side opening in camera permitting the operator to insert his hand to focus the objective.

O: Sliding panel used to close Opening K-N when the image is in focus.

P: Stop block for Panel O.

QRS: Opposite end of camera. Here are placed the negative to be copied and the ground glass.

For ease in shipment, the wooden case is not over 22 inches long.

Film prints are made from a negative, which may be full plate (6½x8½"), half-plate (4¾x6½"), *or carte de visite* (2½ x 4") in size. The negative is placed at the far end of the camera, at QRS, set up in front of a window and facing full daylight. The parallel light rays which pass through the negative are brought to focus on the photographic plate by the objective of short focal length, and produce an exceedingly minute image.

We use the Taupenot Process of photography, as we shall see in Part 2.

By following our instructions carefully, you will find no difficulty in focusing.

Be careful, while looking through Microscope E, to focus the microscope in such manner that will clearly separate the lines scribed on the micrometer scale placed in the focal plane. When you see the scribe lines are as sharp as possible, you are ready to focus the image by racking the objective lens in or out as you did the microscope. By turning the focusing screw one way or the other you will soon see the image form on the little glass plate; if you have had any experience at all with conven-

tional photography, it will be easy to recognize the degree of sharpness of focus. You then remove the micrometer scale and put in its place the photographic plate.

Exposure varies from 1 to 3 seconds, depending on whether the light from the sky is strong or weak.

When you feel the exposure is complete, advance the multiple-back plate holder one notch, then a second, and so on up to 8. Next, take the plate from the holder and develop it according to the instructions given in Part 2.

We also make cameras having 3, 6, 9 or 15 lenses; procedure is identical, but we suggest that photographers who have only single portraits to copy should not use cameras other than the single lens model because in between 8 and 15 seconds you can make 8 portraits on a 2 by 7.5 centimeter plate (roughly 1 x 3 inches, or the size of a microscope slide).

A low magnification hand lens, is necessary to follow and judge the development of the image by inspection.

This magnifier is used only during development; a microscope of higher power is needed for inspection after processing to determine that the image is perfect and worthy of being affixed to the little Stanhope cylinder or gem.

The photographs, once selected, are cut apart in little squares with an ordinary diamond cutter. Be careful that no dust is permitted to remain on the image side of the little square. Next place the Stanhope or the gem for a short while on the lid of a stove which is just slightly warm. Coat the flat surface of the Stanhope or gem with a little Canada balsam; take the little square of glass with tweezers, and press it (lightly at first, then more firmly) against the coat of Canada balsam and let it stand.

To insure that the operation is successful, that the contact is perfect and bubble-free, inspect the rounded end of the cylinder or gem under the microscope, to see that the image,

when enlarged and sharply focused, is fixed to the base. If bubbles are still present, you have not pressed the glass firmly enough against the Stanhope's base. Place the assembly on the stove lid for a moment to melt the Canada balsam a little, and start the mounting operation over again, being more careful this time.

Because making Stanhopes and gems (real or artificial) is outside the realm of photography, we sell all these objects cut and finished at one end with a rounded or spherical surface, at the other with a flat surface in the exact focal plane of the microscope formed by the spherical end.

To finish the job there remains only the trimming or rounding off the Stanhope and the plate, where they do not match evenly; an inexpensive optician's grinding wheel is excellent for this purpose.

Another tool, more expensive, the optician's lathe, can be used to advantage, but it will be useful only to those who intend to do this in great quantity.

PART 2

Operating Instructions

The glass plates, as we said in Part 1, are the size of the opening in the camera, 7.5 centimeters by 2 centimeters high. To avoid preparing each little plate separately, we have standardized on a plate height of 18 centimeters (about 7 inches). Once the 18 cm. plate is sensitized it is cut into 2 cm. strips, thus providing 9 plates all ready to be placed in the camera, one after another. You will find this means, together with a large time-saving factor, greater ease in cleaning and preparing the plate.

I. Cleaning the Plate.

We never use tripoli (diatomaceous earth); chalk solution has the double advantage of being very inexpensive and of never scratching the glass.

We use it in the following formula:

Water	1,000 cc.
French Chalk	50 grams
Alcohol (40 Baumé)	200 cc.

Mix well.

You can use the mixture immediately.

Pour several drops on the glass plate and spread it with a cotton pad; repeat on the back surface. When both sides have been well rubbed and well cleaned, wipe them dry, first with a second pad of dry cotton, then with a soft chamois. If you use wet collodion, this preliminary cleaning will perhaps suffice, but the subsequent use of albumen requires the greatest precautions. You will, therefore, do well to clean the plate a second time, but now only on the surface which will hold the sensitive layer. We in our laboratory use for this last operation a little leftover collodion.

II. *Preparation of the Collodion. (Taupenot Process)*

In this process, the collodion must be a little more fluid than normal. To achieve this, we use:

Ether (62 Baumé)	100 grams
Alcohol (40 Baumé)	25 grams
Ammonium iodide	1 gram
Ammonium bromide	25 grams

Stir well and let stand 24 hours. Then pour off and let stand another 12 hours. The collodion now will be perfectly clear.

III: Preparation of the Albumen.

6 egg whites, making albumen	150 cc.
distilled water	15 cc.
Potassium iodide	3 grams

Ammonia	5 cc.
White sugar	2 grams
Iodine	a trifle

Beat with a wooden fork or a little whisk for about 10 minutes, or until the egg white is thick enough for the fork to stand in the bowl. Let the albumen stand for 12 hours after which it is ready for use.

Note: In breaking the eggs, take care to separate well the yolks from the whites so that the bowl contains only the perfectly pure whites. When you have a quantity of albumen to prepare, it is better to break the eggs so that the whites are collected in a glass, separate from the bowl. Then, if you accidentally drop a little yolk in with the whites, you will have lost only the whites held in the glass.

IV: Coating the Plate with Collodion and Albumen.

We mentioned in Part 1 that our plates measured 7.5 x 18 centimeters. Now clean one of these plates well. Pass again, as a measure of precaution, a badger skin over the surface which will carry the preparation, then spread the collodion over it.

Next, sensitize the plate thus collodionized by dipping it for 12 to 15 seconds in a bath of:

Silver nitrate, 7 or 8% solution.

After taking it from this bath, wash the plate well in a tank or under a stream of distilled water, so as to get rid of all free silver salts. Next, let it drain for the time required to collodionize, sensitize, and wash a second plate. When the first plate is sufficiently drained, and while it still is wet, spread the albumen over its surface on top of the collodion and in the same manner as you did before. It is well to have handy a jar with filter funnel to catch the excess of albumen.

The plate being thus well prepared and dried, sensitize it a second time, but this time for 15 seconds in a bath containing:

Silver nitrate	10% solution
Acetic acid	10% solution

On taking the plate from this bath, wash it again carefully

under a stream of filtered water and finally in distilled water as you did the first time. Stand the plate in the drain rack, and when it is dry it is ready to use. Unless you are going to be working indoors, place the plate in a dark-slide holder to protect it from all light.

Under these conditions it will hold its sensitivity, not just for several months but even for a year or two.

We should mention that the second sensitizing bath needs to be replenished and filtered often, because the acetic acid which it contains causes it to blacken and at the same time makes it muddy.

Here is how I restore its original clarity: I add to each 100 cc. of working solution:

Kaolin	25 grams

Stir and filter.

The kaolin inevitably weakens the strength of the bath a little. We must now test with a hydrometer the salt content to make sure it is not too low, and add enough nitrate and acetic acid to compensate for the loss we have measured.

Exposure varies with the weather: under strong light one second will suffice, but bad weather may require exposures of the order of 50 to 60 seconds.

Since we make 8 copies on the same little plate, we should be prepared to make these 8 copies at different exposures, thus allowing ourselves to expose the plates one right after another.

V: Developing the Image.

In order to achieve the fine detail we want, it is important that we not make the image come up too rapidly. The developer bath is compounded as follows:

Water	1,000 cc.
Gallic acid	3 grams
Pyrogallic acid	1 gram
Alcohol	25 cc.

If you have just a few films to develop, you can place in the tray about one quarter the amount of solution given above.

Place the plates in the solution for 10 to 20 seconds, then add to the bath:

Silver nitrate, 2% solution 3, 4 or more drops

This will quickly make the image visible. After it appears, lift the plate from the developer and inspect it with the low power hand magnifier. If the blacks and whites are of proper density, and if the images are clear and distinct, do not return the plate to the developer; if, however, the image is weak, re-immerse it in the developer. Check in this manner with the magnifier each plate and each image, up to the point that all have been developed perfectly. When that point has been reached, dip them in a second tray of filtered water to rinse them well, and pass them on to the fixing bath.

VI: Fixing the Film Print.

The fixing bath is composed of:

Filtered water	1,000 cc.
Hypo	200 grams

This 20% solution of hypo is what we have standardized on. But, in fixing as in developing, we must carefully watch the image. It is normally fixed out after 10 or 15 seconds; in examining it for transparency, holding it between you and the light, you can watch without too much trouble the progressive de-iodizing of the silver; afterwards, you must wash the plate well in a tray of filtered water.

After this last operation the photographic work is completely over. Only inspection under the high power microscope remains to check on the work done. If one film image leaves something to be desired, we are always quick to destroy it.

Now place the inspected and passed plates in a tightly covered box and take them as needed for mounting on Stanhope or gem as described in Part 1.

For those photographers who do not wish to undertake the inconvenience of the work, our charges for making the microscopic reproductions from their negatives are as follows:

	On Stanhopes	*On Semi-Precious Gems or Gilded Jewelry*
Single film print	5 francs	10 francs
Half-dozen	8 francs	30 francs
Dozen	12 francs	50 francs

We also try to carry in stock at all times an endless variety of mountings, in jewels of gold, silver, and gold plate; in fancy shell, ivory and other novelties.

We undertake to create gracious and novel specialties in jewelry. Our watch-keys are designed in multiple parts so that you can bring together in a single piece of jewelry all the members of your family, your friends, and all those you hold dear, without increasing the size of the jewel in the least.

VII: Price of Equipment and Accessories for Microscopic Photography.

Complete set of equipment, comprising:	
One brass film unit	
Wooden camera	
Focusing microscope	
Micrometric scale	
Objective lens	
Manipulator stage	
Ground Glass	110 francs
Multiple lens cameras, each lens additional	10 francs
Low-power hand lens to watch development	12 francs
High-power microscope for inspection	30 francs
Optician's grinding wheel	15 francs
Optician's lathe	105 francs
Small sheet-iron warming stove	4 francs

Small cup of Canada balsam	5 francs
Diamond plate-cutter	12 francs
Pair of tweezers to handle small images	75 centimes
Box of extra thin glass plates 7.5 x 18 cm.	12 francs
Empty 25-channel box to hold plates after sensitization and cutting to 2 x 7.5 cm. size	1 franc
Drainrack for plates	3 francs
Stanhopes, per gross	8 francs

Total initial investment required: 212 francs, 75 centimes (about $38.72 in American money in 1864).

CHAPTER 14:

DAGRON'S "LA POSTE PAR PIGEONS VOYAGEURS."

POSTAL SERVICE BY HOMING PIGEON:

REMEMBRANCES OF THE SIEGE OF PARIS
By DAGRON
Sole Government Photographer for all
Official and Private Messages on Film

Short Account of the Voyage of the Balloon *Niepce*, carrying Monsieur Dagron and his associates, and details of the mission they accomplished.

TOURS - BORDEAUX
1870 - 1871

The Balloon *Niepce* left Paris on November 12, 1870, at 9:00 A.M., carrying Messrs:

Dagron, photographer;

Fernique, Professor of Engineering at the Central School of Arts and Manufactures;

Poisot, artist-painter and son-in-law of Monsieur Dagron;

Gnocchi, M. Dagron's assistant;

Pagano, sailor and student balloonist;

plus about 1,320 pounds of apparatus belonging to M. Dagron.

The Balloon *Daguerre* left at the same time as the *Niepce*,

carrying three passengers, mail, pigeons, and the rest of M. Dagron's equipment.

Messrs. Dagron and Fernique were sent by M. Rampont, Director-General of Mails (with the approval of M. Picard, Finance Minister) to establish in the provinces a service of microphotographic dispatches which would be sent to Paris by means of carrier pigeons. This service was established by a decree dated November 10, 1870, and was to be set up in Clermont-Ferrand. M. Fernique was, in addition to helping with the work of M. Dagron, to assume the responsibility of organizing the pigeon service, and also to put into operation a system of communication by rivers which the Delegation already in the provinces had not wanted to do.

REPORT OF M. DAGRON

As the two balloons took off, the wind bore due East. Nevertheless, we took off, accompanied by lively professions of sympathy from a large crowd gathered to attend our departure, the success of this postal expedition being needed to allay so many understandable fears in Paris.

Arriving over the Prussian lines, the *Niepce* was — along with her fellow traveller, the *Daguerre* — welcomed by a lively fusillade. At an altitude of 2500 feet the bullets whistled about us. *Daguerre* was hit and we, with sinking hearts, saw it drop dizzily and fall upon a farm wall a few leagues from Paris; we know now that it was near Ferrières.

One fact, whose consequences could have been terrible for us — and which resulted in the loss of the *Daguerre* — was that the bags of ballast had been made of rotten cotton, and were too flimsy. The sight of the *Daguerre's* gas bag, pierced by bullets, and captured by enemy cavalry which we had seen galloping up, showed us the need to speed our own ascent to avoid the same thing befalling us. But the ballast

bags burst. Throughout the rest of the trip we had to gather up the sand in a plate and throw it out of the passenger basket bit by bit.

By about 1:30 P.M. we had reached an altitude of some 4500 feet. Scarcely two bags of ballast were left and (not knowing whether we were over Prussian-occupied territory or not) we decided that our descent should be made very rapidly in order not to give them time to arrive. We dropped down at a rate of about 30 feet a second. Thanks to the ballast we had left, and to the two ground crew guide ropes which we had with us, our landing was without serious accident, despite a violent wind.

However, the balloon lay over and blew along the ground at considerable speed for about a mile, dragging the basket with us tangled in the basket ropes. The countryside had neither hedges nor thickets to snag the anchor and landing ropes: furthermore, the balloon stopped only when the gas bag's fabric and cords were in such shreds that the wind no longer had anything to get a grip on. The lashing and twisting of basket ropes in crossing gripped M. Fernique by the neck, and he freed himself only by a desperate effort; the same thing happened to M. Gnocchi, who was extricated only by a turning which rolled the basket over.

M. Poisot was the first one able to get out of the basket, and he came to our aid. As for me, a heavy chest hung above my head, started to strike me when, seeing the danger, I pushed it away to one side; the back-swing made me fall on my back with my feet in the air, nearly passing out; my son-in-law pulled me out of this dangerous position.

A number of peasants who had run up told us we were a few miles from Vitry-le-François. They gave us their blouses and caps and put at our disposal two wagons on which we loaded in great haste all the material I had brought.

Hardly had the wagons been loaded than the Prussians arrived and seized one of them. They leveled their rifles at the group of peasants, among whom we were mingled; but, not being able to recognize us because of our prompt change of clothes, they did not shoot. The balloon was captured as well, and it was the securing of it, keeping the enemy most busy, that enabled us to escape their clutches, saving with us, as we went across the fields, the second wagon.

At this moment, M. Fernique set off alone for Coole, where we were to rejoin him, but the hazards of flight took us instead to Vesigneul.

The mayor of Vesigneul, M. Songy, to whom we are forever indebted, agreed to hide us in his attic. On arriving, I had placed in Mme. Songy's pocket for safekeeping the papers and letters in my care. The luggage was quickly hidden under straw in a barn. One chest only remained to be hidden when the Prussians, arriving, carried it off.

Taking advantage of their departure, and knowing they would return soon in greater numbers, M. Songy, without losing any time, put us in his wagon and took us himself to Fontaine-sur-Coole, to the home of the curate, M. Cachier. The latter, having had to billet two Prussian officers the night before and expecting others at any moment, knowing also that we were being pursued, hastened our departure by the rear of his house and out of the area, in order that we might not encounter any Prussians and to avoid any indiscretion on the part of the residents.

M. Cachier recommended us in most obliging manner to his colleague, M. Darcy, the curate of Cernon, where we arrived, exhausted from fatigue and hunger, at 10 P.M.

M. Darcy and his mother were eager to give us the most devoted care and attention. We should also give recognition

to the mayor of that community, who placed himself entirely at our service in a most obliging manner.

M. Darcy wished to have us rest. But, at midnight, we heard a rapping on the door. It was the peasants bringing part of the baggage left at Vesigneul, and warning us the Prussians were on our trail and drawing close. M. Darcy immediately put us on the road for Bussy-Lettrée, where we arrived at 5 A.M. Having abandoned our city clothing at the landing of the balloon, having only a blouse on our backs, we suffered considerably from the cold that frigid night.

The schoolmaster of Bussy-Lettrée, M. Varnier, was in his turn eager, on the good recommendation of the curate of Cernon, to render service to us. He built us a good fire, at which we were able to warm our icy legs, and secured wagons to take us to Sompuis.

We had decided that we would not all enter that little settlement together, so as not to arouse curiosity. M. Poisot, remaining behind, was questioned by a group of residents, who told him that a stranger had shown up the night before at the home of the postmaster, M. Legrand. Believing the stranger might well be M. Fernique, I went to find out and had the pleasure of learning from M. Legrand himself that it was truly our colleague, escaped as ourselves up to then from the hands of the enemy. M. Legrand had himself conducted M. Fernique the evening before to Dampierre. With the greatest kindness he offered to leave again with us for the same destination. We arrived in Dampierre at 1:00 A.M.

In that city, Dr. Mosment cordially offered his hospitality. Hoping to make our journey easier he brought to Dampierre some wagonners who had been given Prussian permits for the transport of wine. One of these drivers, whose name we recall with pleasure, is M. Gautier, esteemed and well-known man in that area.

The equipment we had saved from capture was placed in wine barrels and transported in this manner for some time. We went to Nogent-le-Long, where, on the recommendation of Dr. Mosment, we were amicably received by Dr. Bertrand. In turn, Dr. Bertrand recommended us to the chief of police of Aube, M. Lignier, who was at the time in Pougy.

M. Lignier suggested we go by way of Vandeuvre. We had been on the road eight hours when the people of that vicinity warned us that the Prussians in that place would requisition our horses and wagons. We now had to retrace our steps and take the route through Arcis-aur-Aube, an occupied town. As we could not afford to show our wine casks at the toll gate, we left them in a little village and entered Arcis, where all the inns were full of Prussians.

At the dinner table of the Hotel de la Poste, where we were obliged to eat with the enemy officers, a veterinarian from Hanover (who probably had some doubts about us) insisted on wagering 100 *thalers* with me that Paris would surrender within two weeks. He gave me his card to seal his wager, which of course required a card from me. Needless to say, I didn't accept the bet.

During the night the luggage was repacked in chests and baskets and, at 4 A.M., we left Arcis for Troyes, also occupied. The security officer insisted that we leave the sailor Pagano in Arcis. It was fortunate that we left at night, for we later learned that at 7 A.M. all roads out of the city were guarded.

Our position was not improved in Troyes: we secured horses and wagons only with the greatest difficulty. We are happy to acknowledge that the assistant of M. Joffroy, a merchant of that city, was of great help in this.

We left Troyes for Auxerre at 3 A.M. on the seventeenth of November by the Saint-Florentin road. A large body of

the troops of Prince Frederick Karl (one of the ablest of Prussian generals) was twelve hours ahead of us on the road, which thus bristled with obstacles for us.

Arriving in Avrol, which the Prussians had just occupied, they wouldn't let us leave. M. Poisot went to the quarters of the Prussian Major at the chateau of M. De La Bourdonnaye, and requested authorization to continue our journey. The Major replied that no one could leave Avrol before 8 A.M. the next day, following the departure of the troops.

While I, with my assistant Gnocchi, was dickering with the Prussian sentries and awaiting the Major's answer, we heard rifle shots in the distance. Some sentinels, taking us for Resistance snipers, got ready to give us a rough time; with difficuty I made them wait for the arrival of my son-in-law, who came at just the right moment to announce the Major's order. They let us turn our wagon around, and we were able to reach a village farm. As it began to rain hard we went into a barn, intending to spend the night; but the Prussians lost no time in turning us out in a menacing manner.

The wagon of equipment having been left in the courtyard, the Prussians wanted to search it, saying surely we had come from Paris. I maintained we came from Troyes, and demanded that an officer be brought to verify that fact. The soldiers insisted, while awaiting his arrival, on the chests remaining open. It is to that deplorable fact that I attribute a new loss of several pieces of apparaus important to my mission.

Time passed, and the officer — engaged in sumptuous dining — did not come. During this time the driver of the wagon, who had left his lantern in the barn, returned there to get it. The Prussians, seeing the barn door open again, thought we had re-entered it despite their orders. With lamps from the farmers to light them, they searched for us in order to shoot us.

Happily, we had been able, in the darkness, to reach the exit gate of the farm, crossing the road and entering an inn, where we found still more Prussians. We seated ourselves before the fire. Some officers who left a table in a side room looked at us with distrust and passed near us with drawn revolvers. We stayed up all night in that inn, whose proprietors jumped at the beck and call of the invaders, and we lost hope of completing our mission.

The morning of November 18, the Prussians left for Joigny, but the outriders had not gone two miles before they encountered in Brienon a defense composed of the French National Guard. The fight made the road impassable for us and we had to take our wagon across the fields in a torrential rain, painfully moving forward over plowed and broken land, pushing or pulling for each turn of the wheels. We frequently found deep tracks of the Uhlans' horses which had just thoroughly scouted that part of the countryside before us.

Arriving at the French lines at Mont-Saint-Sulpice, we encountered a difficulty which we hardly expected. The area commander, not wishing to believe that we had crossed with impunity the entire occupied zone, found nothing better than to give us an unkind recommendation for the rest of the trip remaining before we reached Auxerre, where we knew the police chief was aware of our mission.

At Seignelay, this bad recommendation caused us a serious enforced idleness and an appreciable loss of time; our baggage was searched, and a badly informed crowd showed hostility. We left the area escorted by a detachment of the National Guard which conducted us to Monéteau, where a new escort awaited us. However, we should say to the credit of the captain of the Monéteau National Guard (whose name we have with regret forgotten), that not only did he give us protection but he also put his wagon at our disposal, together with

coverings to protect us from the frightful weather, and with his men conducted us to the home of the police chief of Auxerre; we arrived at 11 P.M. crushed with fatigue and emotion. We learned here that the prefect had just received orders from the Government Delegation at Tours to send us there. At Nevers, we found a new telegram from the Government Minister, M. Gambetta, ordering us to come without making any stops and at top speed.

November 21 we finally arrived at Tours at 8 A.M., and presented ourselves immediately at the house of M. Gambetta. M. Fernique, who had been able to reach Tours ahead of us, was summoned to appear immediately. We produced our contract of November 10 with M. Rampont, Postmaster General, signed by M. Picard, Finance Minister.

The Delegation, on the advice of the eminent chemist, M. Barreswil, had also had the idea of reducing the messages photographically, using ordinary processes. In view of this the Delegation had, on November 4, authorized the establishment of a service of this kind.

M. Blaise, a photographer of Tours, had begun the work, but using sensitized paper instead of film. He reproduced two printed pages on each side of the sheet. The degree of reduction was limited by the grain and texture of the paper.

This service begun, in Tours by the Delegation, was unsatisfactory, for between October 26 and November 12, the day of my departure, Paris had not received even one message by pigeon.

Ordered by M. Steenackers, Director of Telegraphic and Postal Services for the Delegation, to furnish a specimen of my microphotography on film, I produced a sample which was found to be entirely satisfactory, and photocopies on paper for messages were discontinued.

My microfilms, in addition to their extreme lightness of

weight, had the great advantage of requiring an exposure of only two seconds on the average, while the paper process required more than two hours because of the inclement weather. Furthermore, its transparency gave excellent results in enlargement, which was done in Paris by means of the electric light.

With the help of my associates I organized immediately the reproduction of official and private messages, which was to be so useful to national defense and to private families. From that moment on I was the only one to make them, under the enlightened direction of M. de Lafollye, Inspector of Telegraphic Services, charged by the Delegation with the carrier pigeon dispatch system. On his advice, the original process was modified and the result—in view of the small amount of material we had been able to save — was more rapid and more economical production.

The newspapers having reported that the Prussians had seized a large part of my equipment, I am pleased to say here that M. Delezenne and M. Dreux (a stock broker of Bordeaux), both advanced photographic amateurs, eagerly offered apparatus similar to mine to the administration, and they were placed at my disposal.

The backlog of messages was quickly disposed of. I am happy to state that — with the effective help of my associates — no delays in transmission were caused by my work. But the removal of the Delegation, and above all the intense cold that paralyzed the pigeons, created serious difficulties.

As long as nothing interfered with the flight of these interesting couriers, the speed of correspondence was truly marvelous. I may cite an example from my own experience:

Needing certain chemicals (pyroxylin-nitrocellulose in particular since it was not available in Bordeaux) I ordered them by pigeon dispatch on January 18 from the firm of Poullenc and Wittmann in Paris, asking that the chemicals be

rushed to me by the next balloon leaving Paris. On January 24 the supplies were delivered to my Bordeaux laboratory. The pigeon had taken only twelve hours to cover the distance from Poitiers to Paris. Ordering by regular telegraph and delivery by railroad would not have done better.

The official dispatches were done with surprising rapidity. M. de Lafollye would bring them to us himself at noon, and the same day at 5 P.M., despite a winter weather exceptionally bad, ten copies were finished and sent back to the administration. We made in this manner thirteen series without being late a single time.

The private messages were made in the same manner. The job was a sizable one for — with the exception of a small number of microfilms which were sent off only six times because they were promptly acknowledged — the majority were done on an average of twenty times, and a few were made thirty-five and thirty-eight times. We also microfilmed a large number of postal money orders: the purchasers were able to transmit their money in Paris just as in ordinary times.

Each microfilm was the reproduction of twelve or sixteen folio-size pages of printing containing, on the average (depending on the size type used) 3,000 messages. The lightness of the films allowed the administration to entrust as many as eighteen films to a single pigeon, giving a total of 50,000 dispatches weighing less than *one-thirtieth of an ounce* all together.

The entire series of official dispatches and private messages which we made during the isolation of Paris, numbering about 115,000, weighed a total of one-fourteenth of an ounce; a single pigeon could have carried them easily. If we wish to multiply the number of dispatches by the number of copies made, we find a total of over 2,500,000 dispatches which we made during the two worst months of the year.

The microfilms were rolled up together in the quill of a feather, which the agents of the administration attached to the pigeon's tail. The extreme flexibility and resistance to water of the films made them ideally adapted to this use.

Moreover, my dry plate has a triple advantage:

1. Being coated only once;
2. Being free of bubbles; and
3. Being free of the tendency to separate from the glass plate support at the appearance of the image. It is simple to process, and not subject to troubles following processing, troubles common to ordinary processes.

I believe it will please many people for me to attach here a specimen microfilm, an identical reproduction of that which I made for the pigeon postal service during the siege of Paris. To give the reproduction greater authenticity, the administration has invested it with its official stamp, to which I have joined my signature. In order to offend no one, the names — and only the names — have been changed.

P.S. I returned in serious illness from Bordeaux. After being held up by the distressing happenings in Paris, my report was in the hands of the printer when my attention was called to certain news articles published by others, notably by M. Lévy of Paris, claiming credit for having made the Government dispatches for the carrier pigeon service. These gentlemen are greatly in error in leading the public astray. They force me to protest these deceitful articles and to vindicate my right by the voice of the press.

I had the good fortune to succeed in my assignment, to the full satisfaction of the Government, as it can testify. Having left Paris to make microphotographs dispatched by pigeon and furnished with a contract from the Postal Administration (signed by the Minister of Finance), this contract was exchanged for another by the Delegation, granting me the repro-

duction of all dispatches without exception, official and private. It is now supremely unjust that others who had nothing to do with it should seek to claim for themselves the benefits of my work.

Chapter 15

THE BALLOON SERVICE DURING THE SIEGE OF PARIS

Although several writers of the 1870's give slightly different data, between 60 and 70 free balloons were released in Paris during the siege, to drift with the prevailing winds over the encircling enemy lines.

The first balloons used were those in existence before the war, tethered to the grounds in the parks of Paris, where they had been used by aerial acrobats in public entertainments and for providing a sideshow attraction for the crowds who wished to get a daring aerial view of the city. It was nineteen years before the Eiffel Tower was to provide the same function.

The siege took place, of course, a third of a century before the Wright brothers flew in the first airplane, yet men had been going up in balloons since 1783. The balloon of 1870 was made with a cotton fabric gas bag, over which rope netting was placed in the manner of a harness. The basket car, or nacelle, was hung beneath the gas bag from ropes attached to the netting. Since much of Paris was lighted by illuminating gas, the city gas mains provided many locations where the balloons could be filled. The lifting capacity of each balloon was limited by the amount of gas it could hold, and therefore by the size of the gas bag.

To stabilize the balloon in free flight, ballast in the form of sand was carried in the nacelle. As the balloon reached a desired altitude, a bleed valve was opened momentarily in the gas bag to let some of the gas escape; if the balloon dipped below the wanted altitude, some of the sand ballast was emptied over the side of the nacelle. Bursting of the ballast bags, strewing the sand all over the nacelle, was to prevent Dagron in balloon number 27 (*The Niepce*) from rising quickly out of the range of Prussian gunfire, and almost cost the passengers their lives.

When used as captive observation points, the balloons were tethered to the ground with dragline ropes. When a balloon was released to take free flight, these drag ropes were paid out gradually by members of the ground crew, preventing drift of the balloon and its cargo until it had risen above nearby trees and buildings. The drag ropes, along with boat anchors which also were carried on free flights, served to snag bushes, walls and trees to bring the balloon in to a landing.

From the moment the isolation of Paris by enemy troops became inevitable, a military balloon service was proposed, and Lieutenant Colonel Usquin was directed to create such an arm of the city's defense. Three aerial observation posts overlooking the Prussian lines were established, and a captive balloon was stationed at each post. The balloon at La Glacière, Boulevard d'Italie, was under the command of Eugéne Godard, the best known balloonist of his day. Twenty years before, Godard had taken off before a fascinated 4th of July crowd of over 20,000 paying customers in Manchester, New Hampshire. With Godard in the basket of the large balloon were Mme. Godard and a horse; an article printed in 1856 says, "he went up like a kite, standing on the back of the horse amid immense cheering". According to Godard, the only complaint received on

his performance was that the horse was not as beautiful as shown in the advertising. The comeliness of Mme. Godard was not recorded.

At Montmartre, in the northern section of Paris, a second balloon based in Place Saint-Pierre, was under the direction of MM. Cornu, Nadar, Duruof, and Dartois. Cornu was a physicist; Nadar was a doctor, writer, inventor, photographer, and balloon enthusiast; Duruof was a professional balloonist, Captain of the Balloon Corps, and later left Paris in the first free balloon; Dartois was a member of the balloon-making firm of Yon and Dartois, competitors of the Godard Brothers. The third balloon, overlooking the southwestern section of the old city wall at the Vaugirard Gasworks, was under the direction of the members of the Society of Amateur Balloonists.

All three balloons were so old and leaked gas so rapidly that they had to be refilled almost constantly. Yet, on September 23, less than a week after the Prussians surrounded the city, the balloon at Montmartre took off with Duruof aboard and landed safely 78 miles away, having crossed the entire city of Paris and the enemy lines. Two days later, the captive at Boulevard d'Italie was cut loose, carrying an aeronaut, mail bag, and the first three homing pigeons. Finally, on September 30, the threadbare old captive at Vaugirard took off and travelled 50 miles before it took a hard landing, breaking the balloonist's arm.

Paris tied its sentimental faith to the balloon system, and began to call for more activity. Most of the remaining carnival balloons were too large, too small, or worn out. The day before the Vaugirard balloon took off, the Godards fastened two (one account says three) small balloons together for additional lift, named the contraption "United States", placed their eldest brother aboard and sent *him* off. With the supply of old balloons now exhausted, several wealthy Americans who

wanted to leave Paris ordered a new balloon from Dartois and Nadar. At the same time, the Government ordered balloons from the Godards and the firm of Yon and Dartois.

To insure ample space for manufacturing the balloons, both companies moved into the now useless railway stations: Godard Brothers into Gare d'Orléans, Yon & Dartois into Gare du Nord. Yon sewed his balloons by machine, while the Godards used 120 women to sew theirs by hand. Eugène Godard placed his wife in charge of the sewing women, and claimed the extra labor cost of hand sewing was more than offset by greater strength of the gas bag.

Several materials for the gas bags were investigated. Silk was excellent, but too expensive. Goldbeaters' skin was delicate and easily ruptured. Two layers of cotton duck cemented together with rubber proved to be too heavy to handle for sewing. The fabric finally selected was a cotton tissue, of the grade called calico or percaline. Yon & Dartois used white cloth, the Godards used colored. To make the cloth gas-tight it was daubed with two or three coats of a varnish made from linseed oil to which a little lead oxide had been added. The rope netting was made of tarred hemp. Once varnished and covered by netting, the balloon was tested for leaks by being blown up by air. The shops soon were putting out a balloon a day, at a total cost of 5,000 francs each. Pure hydrogen was not used to inflate the balloons. Although illumination gas was only one-seventh as buoyant, its use eliminated long and costly preparation of hydrogen: a tube attached to the city mains filled a balloon in a few hours.

Sailors generally were used as balloonists after the supply of professionals was exhausted. They were accustomed to climbing about in the rigging of ships, and the balloon manu-

facturers established schools to train them further in the art of handling a balloon. The first takeoff for each balloonist was a solo, and it had to be good.

By most accounts, 159 persons drifted out of Paris by balloon during the eighteen weeks of siege; these included government officials (Gambetta, Minister of War, was the first), transportation specialists, scientists (Jules Janssen, later a pioneer inventor of the motion picture camera, left on December for North Africa to observe an eclipse of the sum), balloonists, business men and microfilm specialists. To carry these passengers, 65 manned balloons took off (plus one small balloon which carried only nine pounds of postal cards). Fifty-one balloons were owned or chartered by the Postal Department, six by the Telegraphic Service, one by the Ministry of Public Instruction (for Janssen's expedition to observe the eclipse), and seven by private individuals. Of the 65 balloons, two were lost at sea and five captured with their passengers and mail by the Prussians after landing in occupied territory.

The longest flight was by Number 31, the "City of Orléans", which took off twenty minutes before midnight on November 24, and came down the following day at 2:25 P.M. in Norway on Mount Lid, 220 miles north of Oslo. In less than fifteen hours, the balloonist, his passenger, pigeons and mail, travelled over a thousand miles at the unheard-of speed of 70 miles per hour, and set an all-time distance record for balloons up until then. The mail was delivered to the Delegation under the cachet "Paris to Mount Lid by balloon; by foot, boat, sledge, train and stagecoach to Christiana (Oslo); by submarine cable across Norway and Scotland; by telegraph across England, and cable across the Channel to France; and finally by telegraph to Tours". Acknowledgment of receipt of the dispatches was sent to Paris by pigeon on December 1, just

a week after the balloon left that city. The original letters and the aeronauts arrived in Tours somewhat later by steamship and railway.

Fifty-two balloons carried both passengers and mail, twelve carried only passengers. About 3,000,000 letters weighing nearly 10 tons in all) were sent out of Paris by balloon. Some 369 pigeons were sent from Paris by balloon, 73 returned; of these, 8 were lost in Paris, 3 captured by the Prussians and released with false messages and 12 merely brought word of the successful landing of the balloon. Thus, 50 pigeons successfully delivered their cargos of microfilm airmail.

At takeoff, the passengers climbed into the nacelle and piled bags of sand ballast about their feet. Anchor, draglines, and mailbags were hung on the sides of the nacelle. The pigeons were placed in crates beside the mailbags. Other freight, such as Dagron's crates of cameras, glass plates and chemicals, were used as seats or lashed to the support ropes overhead. Pay for the sailors piloting the balloons was 300 francs for the trip.

The record of the Balloon Service is an exciting one. The courage and high adventure of more than 150 men who never before had been up in a balloon, yet who trusted their lives to the unpredictable winds to conduct them safely over enemy lines so they could help in the defense of their country, form a tale of inspired patriotism.

Each flight was different from each other: some balloons were captured on landing in occupied territory, even in Germany itself; one was shot down and the aeronauts imprisoned; two were blown out to sea and never heard of again; one drifted for an entire night, first north, then west, then south, to land within the Prussian lines almost at the gates of Paris.

This is the record these intrepid men left:

1. NEPTUNE: September 23. Old balloon (1200 cubic meters), owned by Duruof.
   Balloonist: Claude Jules Duruof, (Captain, Balloon Corps).
   Passengers: None.
   Pigeons: None.
   Cargo: 275 pounds of mail.
   Distance travelled: 78 miles West.
   Flight Time: 3 hours 15 minutes.
   Note: Fired on by ground troops. Duruof dropped insulting greetings to Bismarck.
2. CITY OF FLORENCE: September 25. Old balloon (1400 cubic meters).
   Balloonist: Gabriel Mangin the Elder.
   Passenger: Lutz.
   Pigeons: 4.
   Cargo: 660 pounds of mail.
   Distance travelled: 25 miles West.
   Flight time: 3 hours 30 minutes.
   Note: All pigeons returned, bringing news that the balloon had landed successfully.
3. UNITED STATES: September 29. Two small old balloons (one 500 cubic meters; one 800) joined together by ropes and planks. Two nacelles.
   Balloonist: Louis Godard (eldest of the three Godard brothers).
   Passenger: Courtin.
   Pigeons: 6.
   Cargo: 128 pounds of mail.
   Distance travelled: 35 miles West.
   Flight time: 3 hours.
   Note: The coupled balloons made landing difficult, and the enemy cavalry followed the dragging nacelle until a detachment of French cavalry arrived and drove off the Uhlans.
4. CELESTE: September 30. Old balloon (780 cubic meters), given to Government by Henry Giffard, renowned French inventor and engineer.
   Balloonist: Gaston Tissandier the Younger (Director of chemical laboratories).
   Passengers: None.
   Pigeons: 3.
   Cargo: 220 pounds of mail.
   Distance travelled: 50 miles Southwest.
   Flight time: 2 hours 20 minutes.
   Note: Tissandier's arm was broken in a rough landing. Ballast carried was a supply of 100,000 propaganda leaflets, some of which were tossed over the side to flutter down on German and French alike; the rest were sent to England after the landing.
5. ARMAND BARBES: October 7. First of the new balloons (1200 cubic meters). Built in 10 days by Nadar, Yon and Dartois.
   Named for: Armand Barbes, patriot leader in the Revolution of 1848.
   Balloonist: Trichet. ("a good aeronaut").
   Passengers: 1. Gambetta, Minister of War).
   2. Spüller (Gambetta's secretary).
   Pigeons: 16.
   Cargo: 220 pounds of mail.
   Distance travelled: 61 miles North. Landed high in the branches of a great oak tree.
   Flight time: 4 hours 15 minutes.
   Note: Gambetta was grazed by a Prussian bullet fired at the balloon as they passed overhead.
6. GEORGE SAND: October 7. Twin of No. 5. Left same time. Private balloon.
   Named for: George Sand, the French woman novelist, then 66 years old.
   Balloonist: Revillod (a wealthy French count).
   Passengers: 1. William Raymond (American citizen).

2. Charles May (American citizen).
3. Cuzon the Elder.

Pigeons: 18.
Cargo: None.
Distance travelled: 66 miles North.
Flight time: 4 hours 30 minutes.
Note: This balloon was also fired on. One of the pigeons returned October 10.

7. NATIONAL: October 8. Old balloon (1200 cubic meters). A private balloon.
Balloonist: Racine.
Passengers:
1. Piper (owner of balloon).
2. Unknown.

Pigeons: None.
Cargo: None.
Distance travelled: 7 miles.
Flight time: About 4 hours.
Note: Landed in a pond situated between French and Prussian outposts. Stayed in water up to their necks for three hours until darkness fell and they could risk moving.

8. WASHINGTON: October 12. First of the 2,000 cubic meter balloons, which became standard.
Named for: George Washington.
Balloonist: Albert Bertaux (professional aeronaut). Injured in landing; later died.
Passengers:
1. Lefevre (being sent to Vienna as Ambassador).
2. Van Roosebecke (expert on pigeons).

Pigeons: 28.
Cargo: 660 pounds of mail.
Distance travelled: 106 miles Northeast.
Flight time: 2 hours 30 minutes.
Note: Balloon and passengers suffered a prolonged dragging across the ground by a high wind. Under ground fire for most of trip, their altitude (3,700 feet) put them beyond effective rifle range. One of the pigeons took over two months to return to its home loft in Paris.

9. LOUIS BLANC: October 12. Last of the 1200 cubic meter balloons.
Named for: Louis Blanc, leader of the Laborite Party.
Balloonist: Farcot (a watchmaker).
Passengers: Tracelet (expert on pigeons).
Pigeons: 8.
Cargo: 275 pounds of mail and a proclamation written by Louis Blanc to the English people.
Distance travelled: 181 miles Northeast. Landed in Belgium.
Flight time: 3 hours 30 minutes.
Note: The balloonist, Farcot, was sent to Lyons to set up a system of observation (captive) balloons in case the Prussians besieged that city. The landing of the *Louis Blanc* was badly handled, the voyagers were bruised.

10. GENERAL CAVAIGNAC: October 14
Named for: General Louis-Eugène Cavaignac, who ran against Louis Napoleon (later Napoleon III) for presidency of the Second Republic.
Balloonist: Godard the Elder (father of the Three Godard brothers).
Passengers:
1. Keratry (Prefect of Police).
2. (Secretary to Keratry).
3. (Secretary to Keratry).

Pigeons: 6.
Cargo: 375 pounds of mail.
Distance travelled: 156 miles East. Landed in occupied territory.
Flight time: 4 hours 45 minutes.
Note: Keratry, the passenger, was slightly injured in the landing, but later became General of the French Army of the West. Papa Godard, over 70 years old, handled the balloon in a highly professional manner. He refused to leave his balloon to the

enemy, and eventually reached Tours with his balloon, his mail, and his pigeons.

11. WILLIAM TELL: October 14. (Also known as the *Christopher Columbus,* and in some lists as the *Jean Bart*).
Named for: William Tell, the Fourteenth Century Swiss patriot.
Balloonist: Albert Tissandier the Elder (an architect, father of Gaston).
Passengers:
1. Ranc (General Superintendent of Police in Tours).
2. Ferrand (Ranc's secretary).
Pigeons: 10.
Cargo: 858 pounds of mail.
Distance travelled: 65 miles Southeast.
Flight time: 3 hours 30 minutes.
Note: The Tissandier brothers had used this same balloon on September 9 in an attempt to hit Paris on a flight from Rouen. This flight was originally scheduled to leave October 12, but a strong wind buffeted the inflated and moored balloon, ripping a hole in the bag. The damage was repaired quickly, and *William Tell* took off two days later.

12. JULES FAVRE: October 16.
Named for: Jules Favre, Vice President and Minister of Foreign Affairs.
Balloonist: Louis Godard the Younger (professional aeronaut).
Passengers:
1. Malapert.
2. Ribot.
3. Beote.
Pigeons: 6.
Cargo: 429 pounds of mail.
Distance travelled: 90 miles Northeast. Landed in Belgium.
Flight time: 5 hours.

13. LAFAYETTE: October 16: (Called the *Jean Bart* in some lists).
Named for: Marquis de Lafayette, who played an active part in the American and the French Revolutions.
Balloonist: Labadie (Naval quartermaster; Godard's first student balloonist).
Passengers:
1. Barthélémy.
2. Daru.
Pigeons: 4.
Cargo: 594 pounds of mail.
Distance travelled: 109 miles Northeast. Landed in Belgium.
Flight time: 5 hours.
Note: There was a violent wind at the landing. Labadie cut the nacelle ropes and let the gas bag soar off.

14. VICTOR HUGO: October 18.
Named for: Victor Hugo, France's most illustrious writer.
Balloonist: Jean Nadal (a draftsman and amateur aeronaut).
Passengers: None.
Pigeons: 6.
Cargo: 968 pounds of mail.
Distance travelled: 158 miles East.
Flight time: 5 hours 45 minutes.
Note: No passengers were aboard because of the weight of the mail. During a near-disastrous take off, Nadal excitedly threw out ballast and by mistake included his breakfast. Nadal joined the Communard revolt in 1871, and became the supply chief to Duruof, Captain of the Balloon Corps. Both men were tried after the Commune was crushed: Duruof was acquitted "as an aeronaut, not a politician," but Nadal was executed.

15. UNIVERSAL REPUBLIC: October 18. (Called by one writer *The Lafayette*).
Balloonist: Jossec (a sailor).

Passengers:
1. Antonin Dubost.
2. Prunières (Secretary to Dubost).

Pigeons: 6.
Cargo: 671 pounds of mail.
Distance travelled: 146 miles Northeast.
Flight time: 2 hours 10 minutes.
Note: The balloon made a hazardous landing in the treetops of the Ardennes Forest. "It was a superb balloon of imposing appearance, checkered in red and black".

16. GARIBALDI: October 22.
Named for: Giuseppe Garibaldi, unifier of Italy. Now at 63, he had come to France to assist her in establishing the Third Republic.
Balloonist: Églésia (professional ground crew man on captive balloons).
Passengers: Paul de Jouvencel (Secretary to Vice President Favre).
Pigeons: 6.
Cargo: 990 pounds of mail.
Distance travelled: 28 miles East.
Flight time: 2 hours.
Note: Scheduled to depart on October 20, the take-off was delayed two days because of adverse winds.

17. MONTGOLFIER: October 25.
Named for: The Montgolfier brothers, Jacques and Joseph, who made the first balloon ascension in 1783, using hot air from a fire burning beneath the bag.
Balloonist: Hervé-Sene (a sailor).
Passengers:
1. Colonel Lapierre (sent out to be General of the Army of the North).
2. General Bourdec.

Pigeons: 2.
Cargo: 858 pounds of mail.
Distance travelled: 355 miles East. Landed in Germany.
Flight time: (Unknown).
Note: Prussians captured the mail and pigeons, but the travelers escaped to Swtizerland.

18. VAUBAN: October 27.
Named for: Sebastian Vauban, Seventeenth Century Marshal of France. One of France's greatest military men, specialist in siege warfare, both offensive and defensive.
Balloonist: Guillaume (a sailor).
Passengers:
1. Reutlinger (diplomat, on way to Vienna, then London).
2. Cassier (expert on pigeons).

Pigeons: 23.
Cargo: 594 pounds of mail.
Distance travelled: 158 miles East. Landed at Verdun.
Flight time: 4 hours.
Note: Voyagers barely escaped being captured. Reutlinger, a Bavarian and naturalized Frenchman was shot, but not seriously wounded. He probably would have been executed if captured.

19. BRITAIN: October 27. A privately owned balloon (1650 cubic meters).
Balloonist: René Cuzon (a sailor).
Passengers:
1. Worth (an English gentleman).
2. Manceau (a French merchant going to England).
3. Heidert.

Pigeons: None.
Cargo: 704 pounds of mail.
Distance travelled: 200 miles East.
Flight time: 6 hours.
Note: The balloon first landed among the Prussians, who opened fire. To save his companions, Mr. Worth (son of an Englishman who was a fashionable dressmaker in Paris) leaped from the nacelle and surrendered.

Freed of his weight, the balloon shot skyward. The panicky Cuzon opened the gas valve and the balloon fell back to earth. Cuzon and Heidert now jumped out, abandoning Manceau, who now shot up to a great altitude. Suffering from the cold, Manceau finally found the vent cord and pulled it, dropping back to earth. He jumped, broke his leg, was turned over to the Prussians by a French collaborationist, and thrown into a dungeon in Mayence, Germany, for two days without care or food. He and Worth were held prisoner until the end of the war, despite strong representations by the British government. Prince Frederick Karl killed all the pigeons save one, which was so pretty he sent it to his mother, Queen of Prussia, who put it in her aviary. Four years later, the bird escaped and flew all the way home to Paris.

20. COLONEL CHARRAS: October 29.
Named for: Col. J. B. A. Charras, Minister of War in 1848 but deported in 1852 by Napoleon III. Died 1865.
Balloonist: Gilles (a cabinet maker).
Passengers: None.
Pigeons: 6.
Cargo: 1,012 pounds of mail.
Distance travelled: 81 miles East.
Flight time: 5 hours.
Note: Gilles was directed to go to Lyons to organize a free balloon service in case that city was besieged. The *Colonel Charras* carried as ballast 5,000 copies of *Journal officiel.*

21. FULTON: November 2.
Named for: Robert Fulton, American inventor.
Balloonist: Gloennec (a sailor).
Passengers: Cézanne (a bridge engineer).
Pigeons: 6.
Cargo: 500 pounds of mail, including news of the abortive Communard meeting of October 31.
Distance travelled: 184 miles Southwest.
Flight time: 6 hours.

22. FERDINAND FLOCON: November 4.
Named for: Ferdinand Flocon, first Secretary of the Second Republic, 1848.
Balloonist: Vidal-Loisset (a circus rider).
Passenger: Lemércier de Jauvel.
Pigeons: 6.
Cargo: 286 pounds of mail, including news of the plebiscite in Paris.
Distance travelled: 206 miles Southwest.
Flight time: 6 hours, 45 minutes.

23. GALILEO: November 4.
Named for: Galileo Galilei, Seventeenth Century Italian inventor of the telescope.
Balloonist: Husson (a sailor).
Passengers:
1. Étienne Antonin (Personal secretary to L. A. Garnier-Pages, member of the 1848 republican government, and a practicing engineer.
Pigeons: 6.
Cargo: 286 pounds of mail.
Distance travelled: 54 miles Southwest.
Flight time: 4 hours.
Note: This balloon landed near the Cathedral of Chartres, and was captured. Antonin later escaped, however.

24. CITY OF CHATEAUDUN: November 6.
Named for: The small city of Châteaudun, Eure-et-Loire, which was almost completely destroyed October 18, 1870 by the Prussians, after a heroic defense by French guerillas and the citizens in standing off an entire Prussian division.

Balloonist: Bosc (a contractor and builder).
Passengers: None.
Pigeons: 6.
Cargo: 1,001 pounds of mail.
Distance travelled: 75 miles Southwest. Landed not far from the the city for which it was named.
Flight time: (Unknown).

25. GIRONDE: November 8. A private balloon.
Named for: Département de la Gironde, of which Bordeaux is the principal city.
Balloonist: Gallay (a sailor).
Passengers:
1. Harbault (a sailor).
2. Barry (a merchant).
3. Gambes (a merchant).

Pigeons: None.
Cargo: 132 pounds of mail.
Distance travelled: 55 miles West.
Flight time: 7 hours 30 minutes.

26. DAGUERRE: November 12. A large yellow and blue balloon.
Named for: Louis Jacques Mandé Daguerre, inventor of the daguerreotype.
Balloonist: Hubert (or Jubert, or Imbert, a sailor. Texts disagree).
Passengers:
1. Pierron (an engineer).
2. Nobécourt (an expert on pigeons).

Pigeons: 30.
Cargo:
1. 572 pounds of mail.
2. Part of Dagron's equipment.
3. One messenger dog belonging to Pierron.

Distance travelled: 25 miles East.
Flight time: 1 hour 45 minutes.
Note: The only balloon actually shot down by the Prussians. The three men and most of the mail and pigeons were captured but a forest ranger found a mail bag and six pigeons, which he sent off to Paris bearing messages of the fate of the balloon. The Prussians used one of the captured birds to take the following message to Paris: "All is occupied by the Prussians, who march on Cherbourg; rural population acclaims them. Orléans is retaken by these devils. Bourges and Tours in danger. Army of the Loire completely defeated. Resistance no longer offers any chance of salvation. — Signed, Lavertujon, in Rouen". Since M. Lavertujon was in Paris not Rouen, the false dispatch was recognized as such, and when the second such pigeon arrived, bearing the message "Tours and Orleans occupied by the enemy," no one was deceived. In 1937, the value of a letter cover with a cachet showing it came from the bag of mail recovered by the forest ranger was 250 francs.

27. NIEPCE: November 12.
Named for: Nicéphore Niepce, partner of Daguerre and inventor of photography.
Balloonist: Pagano (a sailor).
Passengers:
1. Dagron (owner of a microfilm business).
2. Fernique (Dagron's administrative associate).
3. Poisot (Dagron s son-in-law and assistant).
4. Gnocchi (Dagron's laboratory assistant).

Pigeons: None.
technician).
Cargo: 1,320 pounds of Dagron's microfilm equipment and supplies.
Distance travelled: 128 miles East.
Flight time: 4 hours 15 minutes.
Note: The story of this flight is given in detail in Dagron's version in Chapter 14. After the dangerous experience of *Daguerre* and *Niepce* with new anti-aircraft fire, the government

switched from morning take-offs to night ascents, usually timed for about 11 P.M. Thus, the balloons had eight hours of darkin which to pass over enemy lines. The night winds, however, were weaker, and the passengers could not read their altitude barometers nor could they see where they were going. The Prussians were always aware of the take-off schedules, and fired rockets at the highly inflammable balloons; fortunately, they failed to hit a single one. The market value of one of Dagron's microfilms in 1937 was 300 francs, but the purchaser was warned to beware of forgeries.

28. GENERAL UHRICH: November 18. First night departure to avoid Prussian ground fire.
Named for: Gen. Alexis Uhrich, French commander at the Siege of Strasbourg, whose defense of the city held from August 13 to September 27, 1870.
Balloonist: Lemoine the Elder (a professional aeronaut).
Passengers:
1. Prosper Thomas (expert on pigeons).
2. St. Bienbar (guerilla fighter).
3. Chaponil (guerilla fighter).
Pigeons: 36.
Cargo: 132 pounds of mail.
Distance travelled: 15 miles West. Fell near Paris after a wandering course lasting all night.
Flight time: 8 hours 15 minutes.
Note: Balloon was lost, but pigeons and mail saved. These pigeons were the most useful of those sent out of Paris, for 14 of the 36 returned to their home lofts bearing messages.

29. ARCHIMEDES: November 21.
Named for: Archimedes, Greek mathematician of the Third Century B. C., whose defense of Syracuse held off the besieging Romans for three years.
Balloonist: J. Buffet (a sailor).
Passengers:
1. Saint Valéry (expert on pigeons).
2. Jaudas.
Pigeons: 21.
Cargo: 660 pounds of mail.
Distance travelled: 250 miles Northeast. Landed in Holland.
Flight time: 5 hours 45 minutes.
Note: Three of these pigeons returned to Paris the following day, bearing between 700 and 800 microprint dispatches made by Blaise. In 1937, the market value of one of these microprint dispatches was from 200 to 300 francs.

30. EQUALITY: November 24. Largest balloon (3,000 cubic meters) to leave Paris. Private balloon.
Named for: The second in the French Revolutionary triad, "Liberty, Equality, Fraternity".
Balloonist: Wilfred de Fonvielle (professional balloonist and science writer).
Passengers:
1. Bunelle (Fonvielle's assistant).
2. Rouze.
3. Villoutrey.
4. Andrécourt.
Pigeons: 12.
Cargo: Private correspondence (only a few letters).
Distance travelled: 131 miles Northwest. Landed at Louvain, Belgium.
Flight time: 3 hours 15 minutes.
Note: Fonvielle went to London to produce anti-Prussian propaganda; Bunelle became director of the balloon corps at Lille. The lunch taken by the passengers has been recorded as ox sausage, roast horse, black bread, claret and coffee. The four cages of

pigeons plus 30 bags of ballast were hung on the outside of the nacelle, an arrangement followed in later balloons.

31. City of Orleans: November 24.
Named for: The city of Joan of Arc.
Balloonist: Paul Rolier (an engineer).
Passenger: Bezier (a guerilla fighter).
Pigeons: 6.
Cargo: 550 pounds of mail.
Distance travelled: 1,000 miles Northeast. Landed on Mount Lid, 220 miles north of Oslo, Norway.
Flight time: 14 hours 45 minutes.
Note: The longest of the flights, at an average speed of 70 miles per hour, twice that of the express trains of the day. The balloon quickly gained over 6,000 feet in altitude after takeoff, and set off northward in a fog. Over the North Sea, dampness forced the balloon down, and it was necessary to jettison a 275 pound bag of mail, after which the balloon rose to 16,000 feet. It came down in Norway, and the voyagers found themselves in desolate, snow-covered territory. They found an empty cabin where they spent the night, thinking they were in Russia. In the morning two men found them, and their trip to Oslo was a tour of triumph, the villagers greeting them with a display of French flags. Even the mail bag thrown into the North Sea was picked up by a Norwegian ship and the mail was forwarded to the addressees.

32. Jacquard: November 28.
Named for: Joseph Jacquard, inventor of the Jacquard knitting process, which the French today call "one of the finest inventions of the industrial revolution".
Balloonist: Prince (a sailor).
Passengers: None.
Pigeons: None.
Cargo: 550 pounds of mail.
Distance travelled: Over 250 miles Southwest. No further word, and balloon presumed lost in the Atlantic off La Rochelle. An English boat later recovered from the sea and forwarded a bag of *Jacquard's* mail. A commemorative plaque to the aeronaut Prince and his balloon was erected at the gare d'Orléans in 1874.
Flight time: (Unknown).

33. Jules Favre, II: November 30.
Named for: Jules Favre, Vice President and Minister of Foreign Affairs.
Balloonist: Martin (a wealthy amateur).
Passenger: Ducauroy.
Pigeons: 10.
Cargo: 110 pounds of mail.
Distance travelled: About 265 miles West. Landed on the island of Belle Ile in the Atlantic, off St. Nazaire.
Flight time: (Unkown).

34. Battle of Paris: December 1.
Named for: The Siege of Paris, now in its 70th day.
Balloonist: Poirier (a gymnast).
Passengers:
1. Lissajous (a French physicist and professor).
2. Hidoux.
Pigeons: None.
Cargo: None.
Distance travelled: About 230 miles West. Landed on shore of Atlantic.
Flight time: Unknown.

35. Volta: December 2.
Named for: Alexander Volta, Eighteenth Century Italian pioneer in electricity.

Balloonist: Chapelain (a sailor).
Passenger: Jules Janssen (leading French astronomer).
Pigeons: None.
Cargo: Janssen's telescopes.
Distance travelled: 260 miles Southwest. Landed at the Atlantic seashore at the mouth of the River Loire.
Flight time: 5 hours.
Note: Professor Janssen was ordered to travel to Oran in North Africa to observe the total eclipse of the sun in December, for the purpose of increasing the accuracy of geodetic maps. British scientists had tried to arrange a safe conduct for him through the Prussian zone, but Janssen felt it would compromise his patriotism and so took his chances by balloon. The landing was a difficult one, made worse by the inexperience of Chapelain, the balloonist. Janssen, however, pushed the aeronaut aside and landed the balloon without damage to the telescopes or the men.

36. FRANKLIN: December 5.
Named for: Benjamin Franklin, American patriot and first Ambassador to France.
Balloonist: Marcia (a sailor).
Passenger: (Unknown). (A military aide to the Governor of Paris).
Pigeons: 6.
Cargo: 220 pounds of mail.
Distance travelled: About 200 miles West.
Flight time: 7 hours.

37. ARMY OF BRITTANY: December 5.
Balloonist: Surrel (a writer).
Passenger: Alavoine (French consul at the Island of Jersey).
Pigeons: 6.
Cargo: None.
Distance travelled: About 200 miles Southwest.
Flight time: 5 hours.

38. DENIS PAPIN: December 7.
Named for: Denis Papin, Eighteenth Century French physicist who performed some of the early experiments on steam power. The Papin Boiler looks much like the globes.
Balloonist: Domalin (a sailor).
Passengers:
1. Delort (co-inventor of the floating dispatch spheres).
2. Robert (co-inventor of the floating dispatch spheres).
3. de Montgaillard.

Pigeons: 3.
Cargo:
1. 121 pounds of mail.
2. Zinc globes for floating postal service.

Distance travelled: About 90 miles West.
Flight time: 6 hours.
Note: The firm of Venoven, Delort and Robert had the day before signed a contract to produce zinc globes 10 inches in diameter, fitted with small vanes to hold them just below the surface of the water. Carrying messages addressed to Paris, the globes were to float into Paris in the River Seine. The concessionaires were to receive 40 centimes per letter placed in the river, and an additional 40 centimes for each one received in Paris. The Prussians, knowing of the scheme, stretched nets across the river, and no globe arrived in Paris until the nets were withdrawn at the armistice; then 800 globes floated into the city.

39. GENERAL RENAULT: December 11.
Balloonist: Joignerey (a gymnast).
Passengers:
1. Wolff (Commissary General of the Armies, on a tour of sanitation practices).
2. Larmanjat (an engineer).

Pigeons: 12.
Cargo: 220 pounds of mail.
Distance travelled: About 65 miles Northwest. Landed near Rouen on the Lower Seine River.
Flight time: 3 hours 15 minutes.

40. CITY OF PARIS: December 15.
Balloonist: Delamarne (a professional balloonist).
Passengers:
1. Morel.
2. Billebaut.
Pigeons: 12.
Cargo: 143 pounds of mail.
Distance travelled: Nearly 300 miles Northeast. Landed near Wetzlar, Germany.
Flight time: (Unknown).
Note: Balloon and travelers captured and interned.

41. PARMENTIER: December 17.
Named for: Jean Parmentier, Sixteenth Century French admiral and explorer.
Balloonist: Louis Paul.
Passengers:
1. Desdouet.
2. (Unknown). A guerilla fighter).
3. (Unknown).
Pigeons: 4.
Cargo: 300 pounds of mail.
Distance travelled: About 100 miles East.
Flight time: 7 hours 45 minutes.

42. GUTENBERG: December 17.
Named for: Johann Gutenberg, Fifteenth Century German inventor of the printing press.
Balloonist: Perruchon (a sailor).
Passengers:
1. d'Almeïda (Physicist of the Ministry of Public Instruction).
2. G. Lévy (a photographer and competitor of Dagron's).
3. Louisy.
Pigeons: 6.
Cargo: None.
Distance travelled: 128 miles East. Landed nearly where Dagron had landed in *Niepce* over a month before.
Flight time: 7 hours 30 minutes.
Note: Professor d'Almeïda and M. Lévy were sent to expedite the pigeon postal service. Dagron complains in his "La Poste" (see Chapter 14) that Lévy later falsely claimed credit for doing Dagron's work.

43. DAVY: December 18.
Named for: Sir Humphrey Davy, England's foremost chemist at the beginning of the Nineteenth Century.
Balloonist: Chaumont (a sailor).
Passenger: Deschamps.
Pigeons: None.
Cargo: 55 pounds of mail..
Distance travelled: About 170 miles Southeast.
Flight time: (Unknown).

44. GENERAL CHANZY:
Named for: General Alfred Chanzy, commanding the Second French Army of the Loire.
Balloonist: Léopold Verrecke (gymnast and performer on captive balloons).
Passengers:
1. Lepinay.
2. Julliac.
3. Berrel.
Pigeons: 4.
Cargo:
1. 55 pounds of mail.
2. Underwater diving apparatus.
Distance travelled: About 400 miles Southeast. Landed in Bavaria. Captured and interned.
Flight time: 8 hours.
Note: The freight cargo included diving gear for an attempt to let men walk back into Paris along the bed of the river. All material and mail was confiscated, of course.

45. LAVOISIER: December 22.
Named for: Antoine Laurent Lavoisier, one of the founders of modern chemistry in the Eighteenth Century.
Balloonist: Sauveur-Ledret (a sailor).
Passenger: Boisdeffre.
Pigeons: 6.
Cargo: 385 pounds of mail.
Distance travelled. About 175 miles Southwest.
Flight time. 6 hours 45 minutes.

46. DELIVERANCE: December 23.
Balloonist: Edward Gauchet (a merchant).
Passenger: Reboul (inventor of glass globes for the floating dispatch service).
Pigeons: 4.
Cargo:
1. 242 pounds of mail.
2. Globes for floating postal service

Distance travelled: About 280 miles West.
Flight time: 8 hours 15 minutes.
Note: After the 10-inch zinc globes of Delort and Robert had been intercepted by the Prussians (see Balloon 38, the *Denis Papin*), Reboul was sent to the provinces to try out his tiny glass globes. They passed through the German nets, but were crushed by ice cakes in the river. M. Lacoin proposed using very small rubber balls to avoid breakage, but the system was not put to the test. M. Duchemin proposed using old corks, on the theory the enemy would not bother to inspect an item so common in the Siene; the indiscretion of the press killed this scheme by giving it away.

47. ROUGET DE LISLE: December 24.
A private balloon.
Named for: Rouget de Lisle, composer of the French national anthem, *La Marseillaise*.
Balloonist: Jahn (a sailor).
Passengers:
1. Glachant (a merchant).
2. Garnier (a merchant).

Pigeons: None.
Cargo: None.
Distance travelled: About 130 miles West.
Flight time: 6 hours 45 minutes.

48. MERLIN DE DOUAY: December 27.
A private balloon.
Named for: Philippe-Auguste Merlin de Douay, Eighteenth Century French judge.
Balloonist: Griseaut (a guerilla fighter).
Passenger: Eugène Tarbe des Sablons.
Pigeons: None.
Cargo: None.
Distance travelled: About 150 miles South.
Flight time: 7 hours 15 minutes.

49. TOURVILLE: December 27.
Named for: Anne de Tourville, Seventeenth Century French admiral.
Balloonist: Moutet (a sailor).
Passengers:
1. Miège.
2. Siméon Delaleu.

Pigeons: 4.
Cargo: 352 pounds of mail.
Distance travelled: About 250 miles South.
Flight time: 9 hours.
Note: Moutet, the balloonist, was one of the two men (Reginensi of No. 50 was the other) out of 50 making the attempt who were able to make their way back into Paris with messages from the Provinces.

50. BAYARD: December 29.
Named for: Pierre de Bayard, Sixteenth Century French captain who single handedly held the Bridge of Garigliano against

a force of 200 Spanish cavalrymen.
Balloonist: Reginensi (a sailor).
Passenger: Ducoux (Director of the Paris Stagecoach Company).
Pigeons: 4.
Cargo: 225 pounds of mail.
Distance travelled: About 240 miles Southwest. Landed about 5 miles from the seashore.
Flight time: 7 hours.
Note: Reginensi later succeeded in returning to Paris through the Prussian lines. (See note on No. 49).

51. ARMY OF THE LOIRE: December 31.
Balloonist: Lemoine the Son (professional balloonist).
Passengers: None.
Pigeons: None.
Cargo: 550 pounds of mail.
Distance travelled: About 100 miles Southwest.
Flight time: 8 hours.

52. NEWTON: January 4, 1871.
Named for: Isaac Newton, Eighteenth Century British physicist, propounder of the Law of Gravity.
Balloonist: Aimé Ours (a sailor).
Passenger: Brousseau.
Pigeons: 4.
Cargo:
1. 209 pounds of mail.
2. 471 pounds of freight.
Total: 680 pounds.

Distance travelled: About 50 miles Southwest.
Flight time: (Unknown).

53. DUQUESNE: January 9. A blimp with hand-operated propellors.
Named for: Abraham Duquesne, Seventeenth Century French admiral.
Commander: Richard (a naval quartermaster).
Crew:
1. Aymond (a sailor to turn propellor).
2. Chemin (a sailor to turn propellor).
3. Lallemagne (a sailor to turn propellor).

Pigeons: 4.
Cargo: 220 pounds of mail.
Distance travelled: 100 miles Northeast. Landed near Rheims Cathedral. Commander Richard was gravely wounded during the landing in occupied territory, and was left for dead by the sailors.
Flight time: 7 hours.
Note: Although great hopes were held that a balloon could be driven through the air as one would drive a ship; and although several members of the Academy of Science held high enough hopes for the *Duquesne* to be present at its launching; yet this was the only attempt at directional flight during the siege. The *Duquesne*, because its gas bag was round rather than cucumber-shaped, as in modern blimps, merely rotated when the propellors were turned. Admiral Labrousse was given credit for designing the *Duquesne*, but it is interesting to note that the *Journal officiel* for October 29, 1870, reported a grant of 40,000 francs to the naval designer Stanislas Dupuy de Lôme to design just such a balloon. *Duquesne* was built in the Godard shops at gare d'Orleans.

54. GAMBETTA: January 10.
Named for: Léon Gambetta, who was directing the war effort in Free France.
Balloonist: Charles Duvivier (a guerilla fighter).
Passenger: Fourey (a guerilla fighter).
Pigeons: 3.
Cargo:
1. 50 pounds of mail.
2. 480 pounds of freight.
Total: 530 pounds.

Distance travelled: 110 miles Southeast.

Flight time: 11 hours.

55. KEPLER: January 11.
Named for: Johann Kepler, Seventeenth Century German astronomer.
Balloonist: Roux (a sailor).
Passenger: Dupuy.
Pigeons: 3.
Cargo:
1. 55 pounds of mail.
2. 341 pounds of freight.
Total 396 pounds.
Distance travelled: 188 miles Southwest.
Flight time: 5 hours 45 minutes.

56. MONGE: January 12. A private balloon.
Named for: Gaspard Mongé, French mathematician at time of Napoleon Bonaparte. One of the founders of the Polytechnical School.
Balloonist: Raoul (a sailor).
Passenger: Guinier (a merchant).
Pigeons: None.
Cargo: None.
Distance travelled: About 140 miles South.
Fligh time: 4 hours.

57. GENERAL FAIDHERBE:
Named for: General Louis Faidherbe, commander of the French Army of the North.
Balloonist: Van Seymoutier, guerilla fighter).
Passenger: Hurel (expert on dog training).
Pigeons: 2.
Cargo:
1. 132 pounds of mail.
2. 5 dogs trained to home on Paris.
Distance travelled: 360 miles Southwest.
Flight time: 10 hours 30 minutes.
Note: Hurel planned to insert messages in the dogs' collars and release them some 25 to 30 miles from Paris. The owners of the dogs were to receive 200 francs for each dog's trip into Paris within 48 hours of release. Newspaper articles warned the hungry Parisians not to kill the dogs, so the Prussians learned of the scheme and not a dog got through.

58. VAUCANSON: January 15.
Named for: Jacques de Vaucanson, Eighteenth Century gadgeteer.
Balloonist: Clariot (a sailor).
Passengers:
1. Valade.
2. Delente (inventor of submarine).
Pigeons: 3.
Cargo: 165 pounds of mail.
Distance travelled: About 150 miles Northeast. Landed in Belgium, near Flanders.
Flight time: 6 hours 15 minutes.
Note: Delente planned to build a submarine on wheels which could crawl along the bottom of the river and thus evade Prussian eyes. "M. Delente did not return in his submarine boat; the armistice, which rendered his efforts unnecessary, is perhaps one of the reasons".

59. STEENACKERS. January 16.
Named for: François Frédéric Steenackers, Communications Director in Free France.
Balloonist: Vibert (professional aeronaut).
Passenger: Gobron.
Pigeons: None.
Cargo: None.
Distance travelled: About 300 miles. Landed in Holland.
Flight time: (Unknown).

60. PARIS POSTAL SERVICE: January 18.
Balloonist: Tourbiaux (a mechanic).
Passengers:
1. Clairet.
2. Cailhorse.
Pigeons: 3.
Cargo: 154 pounds of mail.

Distance travelled: About 300 miles. Landed in Holland.
Flight time: (Unknown).

61. General Bourbaki: January 20.
Named for: Gen. Charles Bourbaki, Commander of French Army of the East.
Balloonist: Théodore Mangin, (professional aeronaut).
Passenger: Boisanfrey.
Pigeons: 4.
Cargo:
1. 275 pounds of mail.
2. Chemicals ordered by pigeon on January 18 by Dagron.
Distance travelled: About 100 miles Northeast. Landed near Rheims cathedral in occupied territory.
Flight time: (Unknown).
Note: Balloon was burned to prevent its falling into Prussian hands. Mangin and Boisanfrey delivered the chemicals to Dagron in person.

62. General Daumesnil: January 22.
Named for: Baron Pierre Daumesnil, French General at Waterloo.
Balloonist: Robin (a sailor).
Passengers: None.
Pigeons: 3.
Cargo: 616 pounds of mail.
Distance travelled: About 200 miles Northeast. Landed in Belgium.
Flight time: 5 hours.

63. Toricelli: January 24.
Named for: Evangelista Toricelli, Seventeenth Century Italian physicist, inventor of the barometer which was used to determine altitude of the balloons.
Balloonist: Beli (a sailor).
Passengers: None.
Pigeons: 3.
Cargo: 506 pounds of mail.
Distance travelled: About 50 miles North.
Flight time: (Unknown).

64. Richard Wallace: January 27.
Named for: Richard Wallace, an English philanthropist of the time. He probably had backed the Parisians financially in some way.
Balloonist: Émile Lacaze (a sailor).
Passengers: None.
Pigeons: 2.
Cargo: 484 pounds of mail.
Distance travelled: At least 400 miles Southwest. Supposed lost at sea off Arcachon and Bordeaux.
Flight time: (Unknown).

65. General Cambronne: January 28.
Named for: Gen. Pierre Cambronne, Marshal of France at Waterloo.
Balloonist: Tristan (a sailor).
Passengers: None.
Pigeons: None.
Cargo: 44 pounds of mail.
Distance travelled: 170 miles West.
Flight time: 7 hours 15 minutes.
Note: This balloon carried the news that Paris had surrendered.

Chapter 16

THE HOMING-PIGEON SERVICE, 1870-71

During the Siege of Paris, homing pigeons to bring messages back into the city were offered to the Central Government by the Pigeon Breeders' Union and by the two major private societies of racing pigeon owners, L'Espérance and Roitelet. In all, about four hundred pigeons left Paris by balloon, and seventy-three flights returned. Some individual pigeons made several flights, however, and more than three-quarters of the trained birds furnished the Postal Service were lost.

Of the twenty or more varieties of domesticated pigeon, in the Nineteenth Century, two proved to be dependable for carrying messages. The so-called military messenger pigeons were bred by crossing the long-billed Antwerp variety with the short-billed Liège pigeon; their extraordinary powers of flight and highly developed memory for places were enhanced by careful training.

All domestic pigeons are descended from the wild rock dove, which lived in caverns and holes in rocks, but never lived in woods or trees. Its food consisted of grain, nuts, and the tender leaves of wild plants. The soft call of the wild pigeon and its devoted acceptance of responsibility toward its mate

and offspring caused it to become a symbol throughout the ages of gentleness, peace, and affection. During the effective operation of the pigeon postal service of 1870-71, the people of Paris looked upon the birds with an excess of anthropomorphism and love.

The dove, widespread in its wild distribution, was domesticated early: King Solomon had a collection of tame doves three thousand years ago, and the Book of Isaiah makes reference to the dovecotes of the Persians of 500 B.C. As the ancient owners of pigeons saw their flocks breed, they noticed an occasional mutant with stronger wing muscles, greater devotion to its home nesting place, greater intelligence or more stamina. Anticipating by many centuries the controlled crossbreeding experiments of Gregor Mendel, the pigeon fanciers began isolating these superior individuals and mating them with each other. It seems that the ancestors of the modern homing pigeon were not hybrids between species, but were the product of careful inbreeding within the single species *Columba livia*. The great fertility of this pigeon, plus the permanent retention of the desired characteristics when bred in and in, parent with offspring, sibling with sibling, quickly produced a stable strain of birds capable of strong and swift flight, and fidelity to the homing instinct. These and other results of a millenium of development of the pigeon's varietal characteristics provided Charles Darwin with data from which he drew heavily for his conclusions on the operation of the characteristics of natural selection.

The pigeon fancier of early days soon progressed from simple cages to large houselike boxes with multiple compartments for individual and paired birds. These houses became and still are known as dovecotes, columbariums, or lofts.

Sooner or later, it was inevitable that men would see in the homing pigeon a winged messenger to carry short notes

back to its home loft. The practice probably started when a nobleman took a favorite bird with him on an extended trip, releasing the pigeon when a day's ride from home on his return, thereby apprising his household that they might expect his return on the following day. Evidence points to this usage in ancient Asia, in Imperial Rome, and during the medieval Crusades.

From here it was a short step to using the flying couriers as military messengers. During the struggle for power in the Roman Empire after the assassination of Julius Caesar, Marc Antony led the forces of the Second Triumvirate against Brutus and bottled up the forces of Brutus in Mutina (now Modena, in northern Italy). Brutus, seeking assistance from the Consuls, used homing pigeons to carry word of his plight to his allies across the lines of siege. The message was delivered, the armies arrived, Brutus was saved. Military pigeons have been and still are used regularly in the United States Army and the exploits of individual birds became widely known. Cher Ami, a World War I messenger, came home with one leg shot away, but the message intact and hanging from a tendon.

The homing pigeon is a bird of considerable stamina and strength. By the time it is one year old, a trained pigeon will home over a 100-mile distance. At the age of two, the same bird, now heavier and more experienced, can be expected to double its range, while a fully matured, well-trained bird will reliably perform over a route 500 or even 1,000 miles long. Altitude of flight will range from about 400 feet to 1,000 feet in good weather, but overcast forces the pigeon down to where it can see and recognize landmarks to guide it on its way.

Flying speeds of homing pigeons depend on many factors: age and strength of the bird; weather and wind conditions; familiarity with the route; competence of the trainer. The average bird will cover about 35 miles per hour, while speeds at

times may run well over 60 miles an hour. During pigeon racing meets some birds will arive home promptly, while an occasional one will straggle in days later. Weight of the message load a one-pound bird can carry successfully is limited to about a thirtieth of an ounce.

The excitement and lavish affection bestowed on the homing pigeons during the Siege of Paris was best described in a feature in *L'Illustration* in February, 1871:

"A pigeon! A pigeon! —and the crowd rushed up, and all eyes followed the aerial messenger which flew to the windows, to the roofs. All hearts pounded at the thought of the messages which the flying courier brought attached to his charming plumage. Why shouldn't the crowd be emotionally moved! Were not these messages as dear to us as the twig brought by a dove to the refugees on Noah's Ark? They brought us news from our exiled loved ones; in a few hours they would give us news of the Fatherland, of our armies, of our valiant Provinces. It was a part of ourselves which was carried on the wings of the bird. The crowd, trembling, seemed so numerous, so clamorous, that the Government deemed it necessary to step in; and so a note in *Journal officiel* warned the inhabitants that this tormented chasing of our messenger pigeons would have precisely the opposite effect to that which Paris expected, in frightening the poor tired bird and making him lose his way.

"We have seen them, these winged factors of our aerial post, at M. Dérouard's and at M. Goyet's, whose dovecote perches picturesquely atop his house in rue de Magenta. Our arrival put the birds to flight, and we were tempted to say, The wildness of them! But at the sight of their masters the affectionate birds returned, cooing, to search for grains of food in their hands. Why not confess it here? It is not without a certain fondness that we have taken, examined, and caressed these precious birds. The homing pigeon is of medium size, about

half way between the turtle dove and the wood pigeon. Its build is short and stout. The head is wide between the eyes, which protrude and stare. The neck is short and filled out. The wing is powerful and of good spread. The tail is narrow, the quill feathers completely overlapping. The feet are bare, short, and rather primitive. The coloration is extremely variable, but the dominant color is blue, speckled with numerous black spots . . .

"Memory of the pigeon remains one of the most touching emotions of the siege. That many of us had had for years the caged pigeon as a house ornament bespoke our fondness for it. The poetic imagination of the Greeks had made the bird dear to Venus, and the Moslems relate that Mohammed had trained one of them to peck at his ear: it is through this divine bird that the Prophet pretended to receive word from Heaven. But never, I am sure, has the pigeon rendered so many services to any people as to us, never has it made the heart beat so lively.

"The City of Paris, which carries a ship on its coat of arms, should engrave there the bird which so many times we acclaimed as the dove bringing good news."

Chapter 17

BIOGRAPHICAL NOTES ON SEVERAL PERSONS CONNECTED WITH NINETEENTH CENTURY MICROFILMING

ALMEÏDA, JOSEPH CHARLES D'
(1822-1880)

French member of the Scientific Commission for National Defense during the Siege of Paris; photographic experimenter. Almeïda acted as liaison between Dagron and Fernique and the Central Government of Paris. He left Paris by balloon number 42 (the (*Gutenberg*) with his assistant Lévy. A founder of the French Physical Society, Almeïda created the *Journal de physique*. For 25 years he was a professor of physics at Henry IV High School in Paris, then became Superintendent of Public Instruction. In 1881 the French Physical Society opened a subscription to raise a monument to Almeïda for his services during the Siege of Paris. He also was a motion picture pioneer, designing in 1865 a stereoscopic viewer, and acting as cameraman in 1874 for Jules Janssen (q. v.) using Janssen's "photo revolver" to record the transit of Venus.

BARRESWIL, CHARLES
(1817-1870)

French chemist. Attached to the Commerce Ministry, he was inspector of child labor. Left Paris for the Provinces, in charge of evacuation of school children from cities threatened with siege; died Nov. 23, 1870 under the strain of his responsibilities. Dagron's son, Dr. Georges Dagron, in 1901, gave credit to Barreswil for having the first idea of using microphotography

in the wartime communications program. He suggested the procedure in Tours to Steenackers, and the Blaise microprint process was begun, later being superseded by the Dagron microfilm method.

BISMARCK, OTTO VON
(1815-1898)

Creator of the German Empire out of the separate German states. As minister under King Friedrich Wilhelm IV of Prussia, he provoked war with Austria, then the leading German kingdom. At the Battle of Sadowa (July 3, 1866), Prussian snipers picked off the Austrian artillerymen (who, although they enjoyed greater numbers of guns, had nothing but muzzle-loading cannon). Bismarck had equipped his Prussians with the new breech-loading cannon, enabling his artillerymen to load without exposing themselves. Prussia won the battle, largely because of this technological revolution, and the muzzle-loader disappeared from warfare. Austria, Saxony, Bavaria, Hanover and the other German states were then united in a loose but powerful federation under the leadership of Prussia. Napoleon III of France, jealous of that power, declared war on Prussia, although there seems to be evidence that Bismarck was equally agressive and forged certain diplomatic dispatches to draw out the French. After the fall of Paris (See Chapter 5), Bismarck consolidated the German alliance into the German Empire under the Prussian king, who became Kaiser Wilhelm I. Bismarck became Chancellor, and guided the Empire until shortly after the Kaiser died. The new emperor, Kaiser Wilhelm II (grandson of Wilhelm I, and instigator of World War I) soon came to feel he had had enough of the "Iron Chancellor" tactics of Bismarck, and forced him to retire.

BLAISE, GABRIEL

Little is known of this man, who made the first microphotographic dispatches sent to Paris by pigeon. He was apparently a professional photographer, with a studio in Tours in 1864-1880. His dispatches were first on conventional photographic paper, later on duplex-coated paper. In 1864 he exhibited carbon prints at a meeting of the *Société française de photographie;* after the siege he continued in Tours and was listed in 1880 as one of the four photoglyptologists (intaglio photoengravers) in France.

BREWSTER (SIR) DAVID
(1781-1868)

Scottish physicist, founder of the British Association for the Advancement of Science (1831). A prolific writer and prodigious research worker,

he invented the kaleidoscope (1816), improved the stereoscope, and — in his articles on "Microscopes" and "Micrometers" published in the *Encyclopaedia Britannica* in 1857 — gave the first widespread publicity to microfilming. These articles were to break the Dagron patent monopoly in 1861.

CORNU, MARIE ALFRED
(1841-1902)

French professor of optics, Polytechnic School of Paris. Worked with Mercadier (q.v.) during the Siege of Paris, in charge of reproduction of microfilm messages.

DAGRON, RENÉ PRUDENT PATRICE
(1819-1900)

French microfilm pioneer. In addition to his microfilm work, he received patents on a system of instantaneous reproduction of designs (1879); a system of color printing on silk paper (1881); a method of preparing and packaging writing inks (1884); a system of perfecting rubber stamps (1889). In 1878 he made some of the earliest aerial photographs on record, using the great captive balloon of Henri Giffard. He and Mme. Dagron had six children, of whom one son, Georges, became a renowned physician and author. One grandson, René II, who was born in 1893, is a successful businessman and engineer in Paris today, who has followed his grandfather's bent in chemical technology and printing inks. As a result of his work during the Siege, René Dagron the elder presented to the government a memoir asking that his original contract be honored, and listing the equipment and materials he had lost because the *Daguerre* had been equipped with faulty ballast bags. The original contract had called for Dagron to be paid 25,000 francs in Tours for the temporary closing of his business and the travel risks to his equipment and life, a life insurance policy of 3,000 francs per year if he were to die during the voyage, and 15 francs per thousand letters or characters reproduced; he was to pay Fernique a part of the latter. Steenackers claimed that Dagron lost only between 8,000 and 10,000 francs worth of equipment, and that in all he made some 52,000 francs off the job, of which he paid Fernique 10%. The post-war government refused Dagron's request, and — according to the family records — he obtained only a high school scholarship in Paris for each of his two sons, plus a plot in perpetual care in Montmartre Cemetery. In later years, Mme. Dagron took over the management of his business, "M. Dagron being above all an

inventor very little preoccupied with material matters". After his death, the business was sold "for a very modest sum" to an employee of long standing, M. Luzatto.

DAGUERRE, LOUIS JACQUES MANDÉ
(1789-1851)

One of the French inventors of photography. Scene painter for the opera. Founded the very successful Diorama in Paris (1822), a gallery where paintings on translucent cloth were, through manipulation of the lighting, made to appear to come alive and move. Started experimenting with photography in 1824; formed partnership with Niepce (1829-1833); discovered principles of the daguerretoype (1832); perfected (1837) and introduced (1839) daguerreotype, first practicable photographic process.

DANCER, JOHN BENJAMIN
(1812-1887)

British optical manufacturer; made first microphotographs on record. In addition to his microfilm work, he invented the photographic lantern slide (c. 1850) a system of electrotyping, an electric doorbell (1838), a stereoscopic camera (1852) a lime-light projector, a tachometer, Dancer's top (a toy), and the Fairy Fountain (colored jets of water, produced by ever-changing hues of light). He was a popular lecturer, supplementing his talks with musical showmanship and an expert exhibition of juggling and magic. Between 1860 and 1877 he presented some 42 contributions and 26 demonstrations before the Manchester Literary and Philosophical Society, on such widely ranging subjects as the influence on public health of flue dust, microscope techniques for examining such dust, solar and lunar eclipses, his 1838 experiments on the production of ozone through electric discharges, and his observations on the relationship of a population of earthworms to the rejuvenation of soil. He and Mrs. Dancer had eight children.

DUBOSC-SOLEIL, JULES
(1817-1886)

French optical maker and photographer. Patented (1852) the Bioscope, or peep-show motion picture viewer. Built arc-lamp projector-enlarger operating from batteries for reproducing Dagron's 1870 pigeon post films to 1600 times original size. Film was placed in a slide carrier and scanned from section to section. The projector throw was about 15 feet. (See *Mercadier*).

DURUOF, CLAUDE JULES

French aeronaut, Captain of the Balloon Corps during the Siege of Paris at a salary of 300 francs per month. Piloted the *Neptune,* first balloon to leave Paris (September 23, 1870). Joined the Communard uprising in 1871 and was brought to trial by the War Councils. Defended by Nadar, Duruof was acquitted on the ground he was politically naive.

FERNIQUE, ALBERT
(- 1898)

French professor at the School of Arts and Manufacturer, advanced amateur photographer. Ernest Picard, Minister of Finance, equipped his laboratory with a Dagron camera for conducting experiments on microfilming the messages of the Siege of Paris; he tried, successively, thin paper, thin mica sheets, and finally the Taupenot dry collodion process. Picard asked Fernique to leave Paris to establish the collodion system, but Fernique suggested Dagron himself should go; Fernique agreed to assist Dagron where possible, to manage the end of the system dealing with the pigeons themselves, and to supervise the plan for using message globes floating down the Seine. Fernique and Dagron signed (November 10, 1870) a contract for these services with Postmaster General Rampont and Finance Minister Picard. He and Dagron left Paris by balloon number 27 (the *Niepce*) on November 12. Threatened with court-martial by Gambetta and Steenackers, Fernique was forced to drop the floating dispatch program, and he devoted all his time, first to handling the explosive situation with Steenackers and, second to helping Dagron set up his laboratory. Fernique's original contract called for 15,000 francs for taking the risk of the balloon voyage, a life insurance policy of 3,000 francs per year if he should die during the voyage, and 15 francs (to be shared with Dagron) for each thousand letters or characters reproduced. Steenackers later maintained that under the renegotiated contract with the Delegation, Fernique was paid 5,200 francs in addition to the 15,000 francs he received in Paris. Fatigue and strain of working with Steenackers caused his health to break down in the last days of the Siege, and it was several weeks before he was able to return to Paris.

FOX-TALBOT, WILLIAM HENRY
(1800-1877)

An English inventor of photography and mathematician. Discouraged by his attempts to sketch landscapes with a camera lucida (1833), he resolved to work on means for making the camera's image permanent.

Using silver chloride paper he succeeded (1835) in producing a paper negative with a 30-minute exposure, and fixed it out with a strong solution of salt water. Since the result was a negative, he contact printed on another sheet of paper, thus originating the negative-positive process. In contrast to the daguerreotype process, which was bought by the French government and freely given to the world's photographers, the Talbotype (or Calotype, as it was also known) was patented, and Fox-Talbot tried to exercise complete control of the process. Fox-Talbot was also interested in other sciences, and enjoys fame among archeologists for being among the first to decipher the cuneiform inscriptions of Nineveh.

GAMBETTA LÉON MICHEL
(1838-1882)

"The one-eyed radical Dictator" lost an eye in an accident at 16. He proclaimed the dissolution of the Empire of Napoleon III and the birth of the Third Republic at the Hotel de Ville, Sept. 4, 1870. He left Paris by balloon October 7 for Tours, where he took supreme direction of the war effort as War Minister. Within a few weeks he had created an army of 600,000 men, an army "which might possibly have effected the relief of Paris had the fortress at Metz held out". Gambetta's three great contributions to France were: preserving her self-respect through a strong resistance after the Emperor had surrendered the army; tactfully persuading the extreme left to accept a moderate Republican form of government; and putting down the uprising by the advisers of MacMahon. The *Illustrated London News* of August 31, 1878, announced the engagement of Gambetta to Mlle. Guichard, who brought a tidy dowry of 18 million francs. Yet the romance of his life was Léonie Léon, with whom he fell in love in 1871. He always begged her to marry him, but she knew it would compromise his career and refused until 1882. She was, however, his intimate political adviser and confidante. Their marriage date had been announced at long last when he was accidentally shot and fatally injured in her home.

GODARD, EUGÈNE
(1827-1890)

The foremost balloonist in France in 1870, he commanded the first balloon observation post in Paris during the Siege. His company, Godard Brothers, manufactured balloons for the government under Madame Godard's direction. In 1850 he appeared in Manchester, New Hampshire, before a crowd estimated at between 20,000 and 50,000 persons; he and Mme. Godard then ascended in a large balloon riding a horse.

HERSCHEL, (SIR) JOHN FREDERIC WILLIAM
(1792-1871)

British astronomer, physicist, chemist. Son of Sir William Herschel, discoverer of the planet, Uranus, Sir John discovered hypo for making photographs permanent (1819), and was one of the first to propose use of microfilm for preserving public records (prior to 1853). Herschel's scientific competence was so great that in January 1839, receiving only word that Daguerre had crowned his 15 years of experimenting with the successful making of a photograph, Herschel analyzed the several possible avenues of approach and within *one week* had succeeded in producing a permanent photograph. His process, differing from both Daguerre's and Talbot's, used a paper coated with silver carbonate, printed out (instead of chemically developed), and fixed in his own discovery of photographic hypo.

JANSSEN, PIERRE JULES CÉSAR
(1824-1907)

The foremost astronomer in France, he was sent to Hindustan to observe an eclipse in 1868, and sent by balloon from Paris December 2, 1870 to observe one on December 22 in North Africa. He later served as President of the International Congress of Photography, and in 1876 invented the "Photo-Revolver", one of the first movie cameras, used in studying the transit of Venus.

MERCADIER, ERNEST JULES PIERRE
(1836-1911)

A French telegraphic specialist, who also did a great deal of important developmental work in acoustics and electricity. Only 34 at the time of the Siege of Paris, he succeeded Steenackers as Director General of Telegraphic Services, and supervised (with Alfred Cornu) the copying and distribution of the microfilm dispatches arriving in Paris by pigeon. After the Dagron films began to overload the capacity of the clerks transcribing from an enlarged image on a screen (the original four clerks were soon swamped, so the number rose to ten, and finally to 67), Mercadier and Cornu decided to make 160 diameter photographic enlargements. Accordingly, they substituted a series of 16 inch dry collodion plates for the screen. After exposure and development, the sheet of collodion was stripped from each glass plate and transferred to a backing sheet of varnished black paper or black cloth.

(*See Dubosc*)

MORROW, JOHN H.

First American to open a commercial laboratory devoted exclusively to microfilm production. According to *Humphrey's Journal* of January 15, 1865, he received technical instruction from both Dancer and Dagron. His advertisement in *American Journal of Photography* (December 15, 1864, et. seq.) reads "Microscopic photographs taken from Carte de Visites, and set in pins and watch charms. Send for circular. J. H. Morrow, 14 John Street, top floor, New York". Wilson's editorial of September, 1866 in *Philadelphia Photographer* gives the address as J. H. Morrow, 629 Broadway, but may have confused the address with that of another photographer not engaged in microfilming: the New York City directories for 1865-1866 give John H. Morrow at 14 John Street, while the directory for 1866-1867 lists a photographer named James H. Morrow at the Broadway address. Coincident with the appearance of John Morrow's 1864 advertisement appeared one by a "William B. Carpenter, Manufacturer of Microscopic Pictures and Lenses, 77 Nassau Street, rear building, rooms 26 and 27". In the light of articles describing Morrow's operation in 1864-66, however, it would appear that Carpenter never achieved any stature or permanent status in microphotography.

NADAL, JEAN PIERRE ALFRED

A French aeronaut, he was supply chief under Duruof for the Balloon Corps during the Siege of Paris and piloted balloon number 14 (the *Victor Hugo.*) He was tried and executed in 1871 for participation in the Communard coup d'etat.

NADAR
(1820-1910)

This was the professional name of Gaspar Felix Tournachon, French caricaturist, writer, balloonist, photographer. Subject of Daumier's still widely known sketch, "Nadar Raising the Art of Photography to a New High", done at the time Nadar was experimenting with aerial photography, Nadar was the best-known portrait photographer in France, partly because of his wide friendship among the bohemian artists of the Third Republic, partly because of his deeply-ingrained sense of showmanship, but mainly because of his technical excellence and imaginativeness in photography. He not only pioneered in aerial photography (starting his experiments in 1855), but created a sensation at the London World's Fair in 1862 by exhibiting a series of startling views taken by electric light in the famed sewers

and catacombs of Paris. He pioneered the candid photograph, and the photographic series known as the photographic interview. Long interested in ballooning, he built the *Giant* (1863), the largest balloon ever made until that time. During the Siege of Paris, he was placed in charge of the entire balloon operation. Nadar's "When I Was a Student" describes his training as a doctor, his change to journalism, his arrest as a spy in Prussia in 1848. His book "When I Was a Photographer" tells of the portraits he made of the great and near-great, of his fashionable studios with elevators, fresh flowers, singing birds, artistic fountains, and special stages for photographing his clients on horseback; he reveled in being called (1862) "the great Barnum of Photography".

NAPOLEON III
(1808-1873)

A nephew of Napoleon Bonaparte, he acquired liberal ideals as a young man and welcomed the 1848 Revolution in France which overthrew King Louis Philippe. Elected to National Assembly of the Second Republic, subsequently elected President of the Republic (December 10, 1848), he immediately began to assert his absolute authority, arrested many republican leaders, and restricted freedom of the press. He proclaimed himself Napoleon III and France the Second Empire (December 2, 1852), caused France to enter wars in Crimea, Austria and Italy, and established (1863) Maximilian as Emperor of Mexico. When he withdrew his support of Maximilian in the face of United States demands, Maximilian was executed by the Mexicans. Seeing the stirrings of German unification on his Eastern border he declared war on Prussia (July 19, 1870), and led the French Army for six weeks until he was forced to surrender with his entire army of 100,000 men at Sédan on September 1. Formally deposed as Emperor, the Empire abolished, and the Third Republic formed by the French National Assembly on March 1, 1871, he was held in Germany as a prisoner until the end of the war when he, with his wife (The Empress Eugénie) and their son (the Prince Imperial), moved to England.

NIEPCE, JOSEPH NICÉPHORE
(1765-1833)

One of the French inventors of photography. Inventor and patentee in 1807 of an engine for boats, he spent the next 20 years improving and exploiting it commercially. Experimenting with photography and photolithography (1816), he worked first with silver chloride paper, then with

bitumen of Judea (a form of asphalt) on glass and pewter. Finally (1826 or 1827), he produced the world's first photograph, taken in an 8-hour exposure on a bitumen-coated pewter plate. Meeting Daguerre (1826), who had been working on the iodine-fumes process, Niepce later (1829) formed a partnership with him. Niepce continued to use the asphalt process on a silvered copper plate, now fuming the plate with iodine; this produced an image in bright and darkened silver, the asphalt being removed in the process. Controversy over the respective contributions of Niepce and Daguerre to making photography a usable art has raged for over a century. A definitive study of the matter appears in Chapters 5 and 6 of Gernsheim (Helmut and Alison): "The History of Photography", London, 1955.

PIKE, NICHOLAS
(1818-1905)

One of the first to use Dagron's microfilm process in America and publish (1863) details of its technique. Colonel Pike was born in Newburyport, Massachusetts, and was given "an excellent education". He moved to New York City about 1841, where he earned a national reputation as one of the most accomplished and successful of amateur artists. He served for six years as U. S. Ambassador to Portugal. A devoted student of nature, he combined photography with his hobbies of ornithology and botany to produce nature photographs of outstanding beauty. He also wrote the first comprehensive American history of photography, published as a part of Marcus Root's "The Camera and the Pencil", 1864.

RAMPONT-LÉCHIN, GERMAIN FRANÇOIS SÉBASTIEN
(1809-1888)

French Postmaster General during the Siege of Paris, he organized the Balloon Postal Service and the Pigeon Postal Service. Later, he played a prominent part in concluding reciprocal postal conventions with Russia, the German Empire, and the United States. Rampont was a physician before he went into politics.

STEENACKERS, FRANÇOIS FRÉDÉRIC
(1830-1911)

The French Director of Telegraphic Services during the Siege of Paris, he was given (on October 12, 1870) jurisdiction over the Postal Service as well. Steenackers ignored the orders sent by Rampont from Paris, and went so far as to threaten Fernique with court-martial and execution if he

persisted in carrying out his contract with Postmaster General Rampont. The post-war Commission of Inquiry into the Acts of the Government of National Defense excoriated Steenackers, who replied vigorously in a 600-page book, "Les Télégraphs et les postes pendant la guerre de 1870". Dagron and Fernique, together with the film system, were damned by Steenackers only because of the cross-fire between the Delegation and Paris, while the microprint system of Blaise was defended because it had been developed by Steenackers and his protege de Lafollye.

TAUPENOT, J. M.
(1824-1856)

French chemist who introduced (September 1855) the first practicable dry plate for photography, used by Dagron and many other early microfilm producers.

TISSANDIER, GASTON
(1843-1899)

French aeronaut, photographer, and author ("En ballon: souvenirs d'un aéronaute"; "La Photographie en ballon"; "Les Merveilles de la photographie", etc.). Editor of *La Nature*.

Chapter 18

EXISTING DANCER MICROFILMS

Mr. L. L. Ardern, Librarian of the College of Science and Technology in Manchester, England, has undertaken the very laborious job of locating and analyzing a surprisingly large number of existing microphotographs made by John Benjamin Dancer.

This project is of such a magnitude that it is but well under way at press time for this book. However, as a companion study to that of Dr. G. W. W. Stevens on the Dagron originals extant (which study is presented in the *Proceedings* of the Eighth Annual Convention of the National Microfilm Association, 1959), it is an important addition to the story of Nineteenth Century microfilming.

A letter from Manchester, dated January 14, 1959, said that "it is possible within another year or so we might have got to 'rock bottom' with perhaps 1/3 of the 512 slides (Dancer) made for sale". The National Microfilm Association hopes to publish Mr. Ardern's definitive paper at that time.

Mr. Ardern has consented most graciously to the publishing in this book of the results of his investigations to date. The following list of 61 specimens represents more than a third of the anticipated number of extant Dancer microfilms. Three

specimens (No. 29: The Creed; No. 262: American River Steamboat *Mayflower; a*nd No. 65: The Giant's Causeway) are to be exhibited in the Historical Section of the National Microfilm Association Convention in 1959.

The author of this book should like to take this opportunity of extending his warm appreciation to Mr. Ardern for the privilege of publishing this interim report and for lending the Association the three Dancer originals for exhibition. My thanks are due also to Mr. R. S. Schultze, Research Librarian and Curator of the Museum, Kodak, Ltd., in Harrow, England, for bringing Mr. Ardern's work to my attention.

COLLEGE OF TECHNOLOGY

Manchester, England

L. L. ARDERN, LIBRARIAN

J. B. DANCER'S MICROPHOTOGRAPHS

List of extant slides in catalogue number order. Present owners shown in code.

The catalogue preamble reads:

"Micro-photographs . All 1/- each.

"Re — The micro-photographic business carried on during the past 40 years at Manchester by E. E. Dancer & Co.

"Mr. R. Suter begs to inform his numerous patrons that he has purchased the above micro-photographic business in its entirety, and has transferred the same to his own address.

"These minute photographs were invented by the late J. B. Dancer, Esq. They average in size 1/100 part of a superficial inch and some contain upwards of 150 portraits."

512 titles are listed. The two most important slides shown in the catalogue are, without doubt,

No. 341 "A brief history of micro-photography" and

No. 342 "Extracts from letters sent by the late Sir D. Brewster to J. B. Dancer relating to micro-photography".

A thorough search should be made for them.

It would seem that some of the later slides were made by Dancer's family or his assistants, for No. 455 is "Jubilee photograph of Her Majesty

the Queen". This could only be 1887 — the year Dancer died. No. 462 is "The Royal Jubilee Exhibition, Manchester" again 1887.

In the following list a (?) has been used to denote either that the number does not agree with the catalogue number, or that it is not quite certain that it is a Dancer slide.

1) Memorial to Sturgeon. 4.
10) The Empress Eugenie. By Winterhalter. 1, (2 copies); 7; 10.
13) Sir David Brewster from life photographed by M. Szabo. 1; 8.
15) The Arctic Council discussing the plan of search for Sir John Franklin: 13 portraits. 1; 5.
17) Riveaulx Abbey, Yorkshire. 1.
21) Pagoda Fountain, Alton Towers. 8.
26) The Lord's Prayer, illuminated. 6.
27) The Lord's Prayer. 1: 3; 9.
29) The Creed. 1, (2 copies); 3; 5.
30) The Ten Commandments. 1; 5.
31) The Ten Commandments, illuminated. 4.
32) Bolton Abbey in the olden time. 9.
35) The auld man's best argument: by J. Bouvier. 7.
38) Rustic felicity. 7.
39) The Imperial Family of Russia, by H. Vernet. 1.
46) A. V. Humboldt. 1.
47) Le General Bonaparte, by Delaroche. 9.
48) Wellington reading his dispatches, by Barker. 4.
50) S. M. l'Imperatrice des Francais. 7.
51) ?A £-20 banknote. 1; 7.
52) Conference of engineers at Menai Straits previous to floating one of the tubes of the Britannia Bridge 1; 8.
53) Prince Frederick William of Prussia. 1.
57) Ecce Homo, by De Rudder. 5.
58) ?The departure: 2nd class, by Solomon. 4; 7.
59) ?The return: 1st class, by Solomon. 7.
60) Suffer little children to come unto me, by A. Hemings. 5.
62) H.R.H. Princess Victoria. 9.
67) Benjamin Franklin, by Schaeffer. 8.
68) Highland shooting pony. 1.
75) Lord John Russell. 1.
78) Hon. George Miffin Dallas. 10.

89) Cromwell and Milton. 3.
90) Charles Dickens. 1.
91) The straw yard. 7.
94) Weighing the deer, by F. Taylor. 4.
98) Notre Dame, Paris. 1; 11.?
103) Cent Francs, Banque de France. 5. (See Fig. 18 for enlarged reproduction.)
108) ?Declaration of independence of U.S.A. 3.
130) Neapolitan peasants, by T. Morris. 1.
146) Les Moisonneurs dans les Marais Pontins. 8.
148) 97 dramatic portraits of the present era. 3.
151) Sir Walter Scott and his friends at Abbotsford. 3.
188) Rustic hospitality. 3.
224) Lord Lyndhurst; Marquis of Lansdowne; Lord Chelmsford; Lord Campbell. 8.
241) ?The origin of species from Blackwood. 7.
247) ?"Pickwick v. Bardell" — Sam Weller's evidence. 11.
248) "Master Humphrey's Clock" — death of Little Nell. 2.
262) American River Steamboat Mayflower. 2.
265) The Giant's Causeway. 3; 6; 7.
267) Belshazzer's Feast, by J. Martin. 11.
268) The fall of Babylon, by J. Martin. 3.
285) Offering of the Wise Men, by Doyen. 2.
298) Sir Isaac Newton, by Vanderbank. 4.
309) Hudibras and the lawyer, by Hogarth. 2
330) The Dame's school. 5.
335) ?The afternoon nap. 11.
380) South Sea Bubble. 2.
382) Death of Nelson. 2.
407) ?Sculpture — Ariadne. 11; 5.
429) The otter and the salmon. 2.

List of Slide Owners

1 Gernsheim Collection.
2 Manchester Central Library.
3 Manchester College of Science and Technology, Library.
4 Dr. R. S. Schultze, Harrow.
5 Kodak Museum, Harrow.

6 Science Library, London, Photographic Collection.
7 Mr. A. K. Bentley, 2 Spring Bridge Road, Manchester, 16.
8 Mr. T. G. Warburton. 96 Homestead Crescent, Manchester, 19.
9 Mr. L. W. Cornelius, Wychwood, Blacksmith's Hill, Sanderstead, Surrey.
10 Mr. H. B. Terry, 534 Brighton Rd., So. Croydon, Surrey.
11 Mrs. O. M. Boyson, 110 Putnoe Street, Bedford.

Chapter 19

THE NATIONAL MICROFILM ASSOCIATION

By Vernon D. Tate, *Executive Secretary*

The National Microfilm Association was organized in 1943 and subsequently incorporated under the laws of the State of Michigan as a non-profit Corporation. Its purposes are to advance the lawful interests of the microreproduction industry by providing a channel of communication for producers of equipment and supplies, service companies and users whether individuals or companies. It is a completely democratic organization headed by a Board of Directors elected by the voting membership. There are nine directors, three of whom are elected each year for a term of three years. From their number the Directors elect a President, Vice President and Treasurer. The Executive Secretary is appointed by the Board.

The work of the Association is largely carried out by Committees in the several fields of interest including Standards, Research, Terminoloy, Publications and the like. Members are encouraged to serve on Committees. Through its educational program the Association has worked to stabilize and improve technical production and use of microtransparencies (microfilms, microfiche) and micro-opaques (Micro-

cards, microprint, micro-ribbon) and to keep producers and users fully abreast of latest developments. The Annual Meeting and Convention, first held in Washington, D.C., in 1952 and each year subsequently following in a principal city, (New York, Cleveland, Boston, Chicago, Rochester and New Orleans) has become an event of great importance. Featured are exhibits of equipment and supplies and a full program of technical and other papers by leading authorities. The published *Proceedings* of these meetings have become important basic sources of information. As only a limited number of *Proceedings* can be published, several are now out of print but are permanently available on microfilm.

In 1954 the Association began publication of an informational news sheet for members, the *National MICRO-NEWS* which now appears six times per year. It contains a lead article, news and technical notes and other material. A consolidated index for the first 30 numbers has been prepared and the text of the numbers is available on microfilm. In 1955 the Association published a *Glossary of Terms Used in Microreproduction* by Hendrix TenEyck. The *NMA Resolution Chart* for use in determining resolution was drawn up and distributed to members. It is currently undergoing revision but will shortly be available in a new form.

The 1959 Annual Meeting and Convention will again be held in Washington, D.C., site of the first Convention. There is in preparation for distribution at this meeting a *Guide to American Microfilm Equipment for Microreproduction.* It will contain illustrations, specifications and other comparable factual information about all known equipment in the field and is expected to contain more than 400 pages. The theme of the 1959 Convention is "A Century of Microfilm Progress, 1839-1959". It is quite fitting therefore that the present

volume by Frederic Luther, *MICROFILM: A History* 1839-1900, the first of a projected series of monographs, will be published concurrently and first shown at this meeting.

The National Microfilm Association welcomes members and the participation of all interested in the field. Complete information may be secured from the Executive Secretary, P.O. Box 386, Annapolis, Maryland.

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